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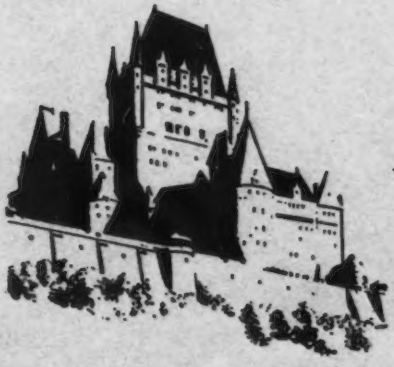

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Canadian Journal of
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VOLUME 45 TORONTO, MARCH 1954 NUMBER 3

The Importance of Sanitation as a Virologist Sees the Problem

G. DEMPSTER, M.D., B.Sc.
Research Associate
Connaught Medical Research Laboratories
University of Toronto

THE control of infection requires a consideration of the agent responsible, its source and mode of spread, and the susceptibility of the particular host involved. There is no doubt in our minds that proper sanitation and the prevention of sanitary defects are of supreme importance in the control of outbreaks of disease, whether they be of bacterial or viral origin. However, the very nature of viruses and the infections which they cause make them worthy of separate consideration in respect of this subject.

It is characteristic of virus infections that patients are infectious in the prodromal period of their illness. Indeed, virus may reach considerable quantity in the body *without causing symptoms*. The majority of viruses are not considered to last long outside the body for they exhibit a supreme degree of parasitism and many cannot survive under ordinary conditions once they are shed from the host cell. There are, of course, exceptions to this rule and we are all familiar with the toughness of the virus of smallpox once it has been desiccated.

Large amounts of virus may accumulate in the body before symptoms appear and, what is even more important, symptoms may never appear. The healthy carrier and the abortive case are more important than the frank illness in the spread of virus infections. If this were not so, how would many of the viruses survive in inter-epidemic periods? True, certain of them make use of other species as hosts, but even in these other hosts the infection may be

Presented before the Health Officers and Sanitation Sections at the forty-first annual meeting of the Canadian Public Health Association, held in the Royal York Hotel, Toronto, October 1 and 2, 1953.

symptomless. On the other hand, chronic carriers are not common features of virus infections. They may exist naturally, as is known in serum jaundice, or they may be artificially produced, as has been recorded in the treatment of psittacosis infection with large doses of penicillin. Because of the existence of healthy carriers and abortive cases, the maintenance of good sanitation under all circumstances is of supreme importance.

Infection may be spread by all the usual routes recognized as responsible for the spread of bacterial infections—contact infections, air-borne infection, pollution of food or milk or water, spread by fomites and by mechanical means involving flies. A large group of virus infections are now known to be transmitted by blood-sucking arthropods. My intention is to confine myself to those diseases which are known to be mainly of gastro-intestinal origin and spread by the oro-faecal route. The most important and well-known of these are infective hepatitis, poliomyelitis, and Coxsackie infections. In these diseases the spread may also occur by droplet infection. Also worthy of consideration is acute gastro-enteritis of non-bacterial origin, a condition from which more than one presumably viral agent has been isolated.

Infective Hepatitis

Infective hepatitis is a disease caused by a virus which exhibits a considerable degree of resistance towards destruction by physical and chemical means. Half an hour's treatment of the virus with water containing 1 part per million of residual chlorine does not inactivate the virus and a similar exposure to as much as 15 parts per million (superchlorination) did not completely destroy the virus (1). The virus has not been shown to produce signs of disease in any other host than man and thus all experimental work upon it has had to be conducted with the aid of human volunteers, a procedure which is rendered all the more cumbersome and difficult to control owing to the extended period of incubation which is a feature of this disease. A period of about 30 days' incubation is usual.

Despite the difficulties of investigating an infection of this kind, there is described in the literature an account of an epidemic of infective hepatitis which was obviously due to a sanitary defect at a summer camp for young boys and girls. Neefe and Stokes (2) in their investigations of this outbreak were able to show that the causative agent was excreted in the faeces of cases, and that water from the well supplying the girls' section of the camp contained a transmissible agent which produced hepatitis in volunteers. Furthermore, they demonstrated that the exposure of volunteers to the agent found in the well water rendered them immune to subsequent challenge with the virus obtained from the faeces of patients who had contracted hepatitis at the camp. Apparently, the well was surrounded by cess pools at distances varying from 75′ to 180′ from it. Bacteriological examination of the well upon two occasions revealed faecal pollution. Other presumably water-borne epidemics have been described in which poor sanitation was evident. Olin (3), for example, described an outbreak in a winter-sports hotel in Sweden. During the war in Italy, Gauld (4) described the occurrence of 86 cases, in a period of 18 days, amongst a mountain infantry regiment. He examined the evidence and found the indications were that a certain well was the source of infection.

Although water-borne epidemics undoubtedly exist and milk (5) and food-borne (6) outbreaks have been described, these modes of spread, which are due to gross sanitary defects, are not commonly responsible for the spread of infective hepatitis. The disease is primarily spread by close personal contact and as a result may be described as a family disease. Secondary cases are commoner amongst families than outside contacts. If this fact is taken into consideration, along with the observation that overt jaundice is commonly absent in the 0–4 year age group, then the ease with which it may be spread may be more readily understood. Thus the disease may be endemic and unrecognised amongst a group of very young children and yet be obvious in their attendants of an older age group. Such a state of affairs was brought to light by Capps and others (7) investigating an orphanage which was experiencing a high incidence of jaundice (33%) amongst the nursing staff. It was discovered that about one-third of the children had signs of hepatitis without jaundice and that the nurses became infected and developed jaundice owing to insufficient care being observed in nursing techniques.

Poliomyelitis

There are many similarities in the epidemiology of infective hepatitis and poliomyelitis. In each disease both a respiratory and an alimentary mode of spread have been considered, and although the respiratory route of infection operates in both diseases, spread by the oro-faecal route is probably the most common. Once again, in poliomyelitis spread by contaminated articles of food, milk, or water is possible but not common. Outbreaks presumably due to milk have been described, but demonstration of the virus in the supposed vehicle of infection has never been made. Maxcy (8) considers that it is extremely unlikely that the poliomyelitis virus would survive the usual precipitation, filtration, and chlorination procedures applied to piped water supplies in sufficient dosage to be responsible for spreading the disease.

It is likely that gross defects in sanitation such as are normally found in primitive conditions would permit of water-borne infections. One has to be wise to the common error of using questionable sources of water for such procedures as the washing out of drinking cups, milk receptacles, and the washing of uncooked fruit or vegetables, especially when limited supplies of suitable water are available. In an account of the outbreak of poliomyelitis on the island of Mauritius (9) it is recorded that the disease may have been spread by homemade ices which consisted of small slabs of ice tied together with a filthy rag.

In attempting to assess the infectivity of the stools from an acute case of poliomyelitis, Melnick (10) calculated that one hundredth of a gram of stool contained sufficient virus to produce an experimental infection in a monkey. On this basis, he reckoned that a patient excretes between one to ten-thousand monkey infectious doses a day. An appreciable quantity of virus may remain alive in raw sewage for many months, and if flies are allowed to gain access to this material they can readily transmit infection to food. Some species of flies (11) have been shown to harbour and excrete virus from such a source for a period as long as three weeks.

In the majority of instances, close contact with an infected person is the usual means by which these diseases are acquired. In the adult we can combat this mode of transference by education in personal hygiene but amongst children the problem is different. As parents amongst you must well know, the normal healthy child goes through a stage when he likes to be dirty and boasts of it.

Another virus which can be recovered easily from the stool and which produces an illness of similar clinical character to non-paralytic poliomyelitis is the Coxsackie or C-group of viruses. Apart from producing this clinical condition, Coxsackie virus has been recovered from cases of paralytic poliomyelitis together with the poliomyelitis virus. Serological examination would indicate a double infection in such cases. There seems to be no end to the versatility of the Coxsackie virus, for it can produce a range of clinical conditions varying from summer grippe to aseptic meningitis. Amongst other syndromes for which it is responsible are epidemic myalgia and an ulcerative throat condition known as herpangina.

As yet, there is little knowledge of the pathogenesis of the disease but certain facts are known. It has been ascertained that the virus can readily be recovered from the stools of the patient, from sewage, and from flies collected during the epidemic season. Melnick (12) in his review reports the isolation of C virus from flies which had been collected during the epidemic of poliomyelitis in New Haven as long ago as 1943. The facts would indicate that here we have another virus, the cause of a great variety of clinical conditions, which may be spread by the alimentary as well as the respiratory route.

The virus tends to spread in family groups and the majority of cases investigated so far have been amongst children. Rises in antibody levels to Coxsackie virus have been recorded in normal healthy individuals during the epidemic season of summer and fall and so we must conclude that it can provoke subclinical infections.

Before continuing our discussion it is worth recalling that viral agents have been recovered from cases of non-bacterial gastro-enteritis and that at least two such agents have been described by Gordon (13). The work upon these viruses is hampered by the need to employ human volunteers, for all attempts to propagate the virus by other means have failed. It has been established that the viruses are distinct from one another and cause different clinical pictures. The one produces a febrile illness and the other merely a local disturbance with no general reaction. Volunteers acquire immunity to the homologous virus following exposure but immunity between the two viruses does not exist.

Why is it that despite the improvements of our standard of living and the efficiency of our modern methods of hygiene and sanitation no impression has been made upon the incidence of diseases like poliomyelitis and infective hepatitis? Why is it that in densely populated countries where primitive sanitary conditions exist the local population suffers no serious depredations from poliomyelitis and yet examination of their sera reveals evidence of its widespread existence in the population? It has been suggested that modern methods of sanitation have removed a source of active immunization. In countries with primitive hygiene there occurs repeated and mass exposure to

the virus at a very early age. This process of latent immunisation may in fact be a combined active and passive immunisation as infants are exposed to sub-infective doses or even infective doses of virus while still in possession of maternal antibodies. Stokes (14) quotes the experiments of Herrman, who, over thirty years ago, exposed infants to measles infection at an age when they still possessed maternal antibodies. There is no doubt that immunity can be conferred in such a manner and, furthermore, similar observations have been made in experimental animal infection such as mouse pox.

Sabin (15), in his extensive world-wide analysis of epidemiological patterns of poliomyelitis, finds this theory of latent immunisation wanting. Indeed, it seems that there is no single satisfactory explanation of this complex pattern.

I think it is worth while asking ourselves whether a country with one hundred per cent perfect hygiene would be one in which we would desire to live. Our opportunities of meeting and defeating the microbial parasites of life would be reduced to nil, and antibody levels would be non-existent. In such a state the slightest breakdown would manifest itself by a massive outbreak of disease. An individual living under these conditions would hazard his life if he took a journey into a country which paid little regard to sanitation. I have taken an extreme example, but it is commonplace today to see individuals reared under conditions of excellent modern sanitation being suddenly transported into lands where the rudiments of sanitation are unknown, far less understood.

Modern civilisation has brought with it new standards of hygiene. We are much more refined in our ways of life. We no longer have the cess pool draining into the well from which we draw our water. We wash our hands before we eat; and when we eat we partake of refined foods pure and unadulterated. So pure are our foodstuffs nowadays that much ingenuity, time and money are spent in putting back into the food the various vitamins we have extracted from it. Can we not draw a similar parallel in hygiene? For every species of microbe that we defeat in our crusade against these hordes we must produce an immunizing prophylactic which will artificially replace the normal immunising stimulus of sub-infective doses. Failing that, we must have at hand some chemotherapeutic substance which will prevent or abort an infection when exposure is likely to occur.

And this is the point which I would like to make. Where the bacterial diseases are concerned, we have in most instances developed suitable prophylactic immunizing agents or have readily available powerful chemotherapeutic or antibiotic substances. As far as the viruses are concerned, it is true that we have some effective immunising procedures, for example in smallpox and yellow fever, but in many other conditions such as infective hepatitis we have not got as far as finding a satisfactory method of propagating the aetiological agent. Viral chemotherapeutic agents are virtually non-existent. Therefore, the complete prevention of our exposure to diseases which we may meet and in most cases master at an early age, in a world where there exists very varying degrees of sanitation, may merely postpone the evil day. As a result, completely unprotected and unable to muster a single therapeutic weapon, we meet the foreign virus at an age when we may be less able to cope

with the disease. The importance of this is readily appreciated when one considers how rapidly in this jet-age people are transported from non-endemic areas with first-class sanitation to endemic areas with primitive surroundings.

At all costs we should avoid transporting groups of susceptible people under such conditions. We must either promote the adoption of first-class hygienic measures throughout the world or avoid the movement of large bodies of susceptible persons into areas where virus infections, for which we have no suitable prophylactic or therapeutic measures, exist. The virologist by developing satisfactory methods of vaccination against viral infections and by searching for active viricidal substances may free us from the risks to which we are exposed by present conditions.

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The Mosquito Problem in Relation to Irrigation Developments in Alberta

JOHN H. BROWN, M.Sc.
Director, Division of Entomology
Alberta Department of Public Health
Edmonton

Introduction

THE public health aspects of mosquitoes in irrigated areas has been the cause for concern in the United States and other countries for a number of years. So far as is known, this problem has not received any study in Canada, probably because the majority of persons in the irrigated areas, which are mainly located in Alberta, are under the impression that mosquitoes are an occupational hazard.

At present some 485,000 acres of land are under irrigation in Alberta south of the Red Deer River. It is estimated that a rural and urban population of approximately 89,000 persons live on or adjacent to irrigated lands. It is expected that the anticipated completion of the St. Mary and Milk Rivers Development within the next five years will bring a further 465,000 acres under irrigation and result in an increase in the rural and urban population of approximately 47,900 persons, making an anticipated total rural and urban population of some 136,900 persons living on or adjacent to irrigated lands.

Mosquitoes require water in order to complete their life cycle. As improperly handled irrigation water provides an abundance of breeding places, it is suggested that the seven species of *Aedes*, two species of *Anopheles*, and one species each of *Culex* and *Culiseta* found in the area constitute a potentially serious agricultural and health problem in the presently irrigated districts. It is anticipated that, unless proper safeguards against the production of additional breeding grounds are established, the enlarging of the irrigated area will be attended by a consequent increase in the numbers of mosquitoes.

It is further suggested that the presently irrigated area and proposed developments be carefully surveyed with the two-fold view of assessing the problem and of eliminating any undesirable practices or construction features conducive to the production of mosquitoes in outbreak numbers.

Mosquitoes

Life History and Habits

Mosquitoes are small two-winged flies, and belong in the order Diptera. They are present in all parts of the Province (3, 16) and are familiar to everyone, as they attack man and animals. Ever since the days of the first settlers the mosquito has been recorded as being the worst pest of the northwest.

Although mosquitoes may vary by species as to abundance and habits, they are all alike in one respect. They all breed in water, and all stages except the adult are passed in water. The

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most abundant species usually develop in temporary pools, such as ditches, ponds of run-off water, and flooded areas in irrigated districts (2).

Contrary to popular opinion, mosquitoes do not breed in grass or shrubbery. They only hide or rest in such places unless, of course, there is standing water present (7).

There are four stages—egg, larva (wiggler), pupa, and adult. The eggs may be laid singly, in clusters, or in rafts on the surface of standing water or on the ground. If they are laid on the ground, they hatch when the ground is flooded following rains or by the melting of the snow in the spring. The number of eggs laid by one adult female varies in different species but probably averages several hundred. In certain species the eggs may remain dormant for two or more years and then hatch when suitable conditions of moisture and temperature occur.

The eggs hatch into larvae or "wigglers" which live in water and feed on organic matter. The larvae have a head and thorax, and a long slender body with a respiratory tube projecting upward at the posterior end. They move about with an undulating or wiggling motion which accounts for their common name of "wigglers". Every two or three minutes each larva comes to the surface to breathe, taking in air through the respiratory tube. After a suitable time (depending upon the species) the larvae transform into pupae. These are quite different from the larvae, having the head and thorax fused together and attached to a long, slender body which is equipped at the end with two paddle-like structures. The pupae are active and move through the water by tumbling end over end. They are air-breathing, and come to the surface every few minutes for air which is taken in by means of two short tubes on the upper side of the thorax.

The pupal stage lasts for only a few days, and then the adults emerge. The adults are winged and fly about. In a few days the females are fertilized, and in some species shortly after start laying eggs. Other species overwinter and lay their eggs in the spring.

The habits of mosquitoes vary with the species. Southern Alberta has a number of species that are vicious biters; some of these bite by day while others bite at night. Those that are not vicious biters cause annoyance through their hum as they fly about at night (3).

Species Known to be Indigenous to the Irrigated and Irrigable Areas

From information presently available (3, 12, 15, 16, 17) it is known that at least seven species of *Aedes*, two species of *Anopheles*, and one species each of *Culex* and *Culiseta* are established in the area under consideration. Under natural conditions these mosquitoes breed in lakes, sloughs, lagoons, dead river water, and other small ponds, reaching outbreak numbers during wet years and subsiding to near normal numbers during dry years. From early records it seems fairly certain that before land settlement began standing bodies of water in the form of sloughs, etc., were common throughout the prairie region, with a consequent high population of mosquitoes. However, the settling of the land with its attendant prairie fires, over-grazing, cultivation, etc., soon reduced the number of ponds so that the whole area became almost an arid plain with a marked decrease in the mosquito population.

The later introduction of irrigation without any proper safeguards in regard to handling excessive flooding, surplus water, etc., resulted in the establishing of many artificial breeding places in close association with human habitations and large settled areas. Consequently, the mosquito problem became very severe but it was accepted by the farmers and others as a necessary evil if they were to enjoy the benefits of irrigation. In fact, it is probable that the majority of the farmers in irrigated areas are under the impression that mosquitoes are an occupational hazard.

Unfortunately, most of the native species flourish under irrigation, as the following descriptive notes will emphasize.

Genus AEDES Meigen

This is a large genus of world-wide distribution varying greatly in habit, and in general addicted to temporary water. A large section is restricted to northern and Arctic regions, where the larvae develop in the snow water of the spring. These species are often abundant and annoying to both man and animals (4). The great majority of the prairie species make their appearance in quick succession (15).

1. *Aedes campestris* Dyar & Knab

This species is probably single-brooded, as the eggs overwinter. It is not very abundant and breeds in alkaline pools in the arid plains regions (15). It also occurs in irrigated districts where it causes annoyance and discomfort to man and domestic animals. It is a severe biter and will bite during the day or night. The peak of abundance is reached in July (15).

2. *Aedes dorsalis* Meigen

This species prefers grassy pools of flood water in irrigated districts and is probably the worst pest in such districts (10). It has a very short life cycle and flood irrigation of alfalfa and pasture lands assures a constant production of new generations (2). It is a vicious biter by night and readily attacks man and livestock. The eggs overwinter and the adults become common by July.

3. *Aedes flavescens* Muller

This one-generation mosquito breeds heavily on the open prairies (15). It is a bad biter of livestock. Although it prefers open pools, it will breed in shallow ditches in irrigated districts (2).

4. *A. nigromaculis* Ludlow

This species is a severe pest in irrigated districts (2), for, like *A. dorsalis*, it has several generations in a year. It attacks both man and livestock, causing great annoyance and discomfort. It is most plentiful during July.

5. *A. spencerii* Theobald

This is the common mosquito of the Canadian prairies (8). It usually has one generation a year and breeds in hollows along ditches and river banks. In irrigated pastures it sometimes has two or three generations (15). This insect attacks both man and livestock. The adults are active during May and June.

6. *A. stimulans* Walker

This is a one-generation mosquito that breeds in flood pools and swamps and marshes. It is not very common (10, 15).

7. *A. vexans* Meigen

This species, despite the fact that it has only one generation a year, is of great importance in irrigated areas. It is a bad biter and often occurs in enormous numbers. It is a serious pest in populated areas (15). Due to delayed hatching, members of this species are active during the entire summer (7).

Genus ANOPHELES Meigen

This genus has a world-wide distribution, especially in tropical and temperate zones, being rare or absent in the North. The larvae occur mostly in permanent pools, running water, and tree holes. The adults fly principally in dusk and some species readily enter dwellings. They overwinter as adults. Most of the species are malaria carriers (4).

1. *Anopheles (maculipennis) occidentalis* Dyar & Knab

The records on this mosquito are sparse but it probably overwinters as an adult. It prefers permanent water as a breeding place. (According to a letter from Dr. J. G. Rempel (14, 15) the species present in Alberta is probably *A. earlii* Vargas and not *A. occidentalis* Dyar & Knab.)

2. *Anopheles punctipennis* Say

This species is also rare, having been reported only from Medicine Hat (12). It overwinters as an adult and lays its eggs in rafts. There are probably several generations a year (10).

Genus CULEX Linnaeus

This genus has a world-wide distribution. The larvae inhabit natural pools and water in artificial containers. Some species become semi-domesticated and are very troublesome in thickly settled areas. Many species transmit blood diseases of birds and animals (4). There are very few species of *Culex* in western Canada (15).

1. *Culex tarsalis* Coquillett

This mosquito overwinters as an adult (10), with the female emerging in the spring to lay her eggs. There are numerous generations a year as it breeds abundantly in weedy roadside ditches (15). It is seldom very numerous, which is fortunate as it readily enters human habitations. The peak of abundance is reached in August (15).

Genus CULISETA Felt

These are large mosquitoes inhabiting the temperate zones. The females overwinter and lay their eggs in rafts on permanent ponds. The adults rarely attack man, preferring horses and cattle (4). Only one species, *C. inornata*, is found on the open prairie, where it occasionally becomes very abundant in late summer (15).

1. *Culiseta inornata* Williston

In this species the female overwinters in sheltered places and emerges in the spring to lay her eggs (10) in masses on the surface of permanent and semi-permanent pools. Usually there are several generations a year. It is not a serious pest of man but will readily attack livestock (15).

IRRIGATION IN ALBERTA

Present Development

The history of irrigation in Alberta (1, 11) dates back to 1894, when water was taken from the Belly River to irrigate hay lands on the Cochrane Ranch in the Cardston district. However, this was not an irrigation project in the true sense of the word, and it was not until some time later that irrigation on a large scale was adopted.

Table I lists the existing irrigation districts with date of organization, the number of irrigable acres, the acres actually irrigated, and the irrigated farm population by districts for 1950.

From Table I it will be noted that in 1950 there were 485,472 acres of land under irrigation, with a population of 28,253 persons living on such land.

The city of Lethbridge and a considerable number of towns and villages are located in the presently irrigated districts, with a consequent exposure of the inhabitants to the attacks of mosquitoes. Table II gives the approximate urban population by districts.

Combining the population of Tables I and II, it is evident that at present some 89,000 persons are living on or adjacent to irrigated lands.

Proposed Development

In 1942 the St. Mary & Milk Rivers Development Committee (11) reported that further irrigation development should be undertaken and proposed that some 465,000 additional acres be brought under irrigation. On the basis of the average farm population in the presently occupied irrigation districts, this would mean an additional population of 27,900 persons living on irrigated lands when the project is completed. Besides these there will probably be an additional urban population of approximately 20,000, making a total of 47,900 persons.

TABLE I

IRRIGATION DISTRICT STATISTICS

Name of District	Year of organization	Classified irrigable area	No. of acres irrigated in 1950	Total population
	(89)			
Alta. Rly. & Irrig. Co.*	1946	143,661 Ac.	77,225 Ac.	4,000
Raymond Irrig. Dist.	1927	15,130 "	12,000 "	520
Magrath Irrig. Dist.	1924	17,924 "	7,000 "	1,206
Canada Land & Irrig. Co. Ltd.	1917	110,000 "	55,000 "	3,000
New West Irrig. Dist.	1922	4,564 "	3,247 "	125
Taber Irrig. Dist.	1919	21,500 "	18,000 "	620
Western Irrig. Dist.	1904 & 1944	75,000 "	30,000 "	4,200
Eastern Irrig. Dist.	1904 & 1935	280,000 "	180,000 "	7,000
Leth. Northern Irrig. Dist.	1920	94,000 "	76,000 "	5,800
United Irrig. Dist.	1921	34,021 "	21,000 "	1,090
Mountain View Irrig. Dist.	1922	3,760 "	3,500 "	132
Leavitt Irrig. Dist.	1936	4,631 "	2,500 "	305
Aetna Irrig. Dist.	1945	8,190 "	Not yet irrigating	255
		812,381 "	485,472 "	28,253

*St. Mary & Milk Rivers Development took over the Alberta Railway & Irrigation Company in 1946.
Compiled 1951
Water Resources (18)

TABLE II

APPROXIMATE URBAN POPULATION BY IRRIGATION DISTRICTS

District	Approx. Urban Pop.
Alberta Railways & Irrig.	26,000
Raymond	3,600
Magrath	1,500
Canada Land and New West	2,100
Taber I.D.	5,000
Western I. D.	5,000
Eastern I. D.	9,000
Lethbridge Northern I. D.	2,500
United I. D.	1,200
Mountain View I.D.	600
Leavitt } Aetna }	4,000
	60,000

Therefore, it can be estimated that when the proposed St. Mary & Milk Rivers Development is completed there will be some 136,900 persons living on or adjacent to irrigated lands south of the Red Deer River.

Health Importance

As is well known, mosquitoes are a serious economic problem in agriculture as they reduce the efficiency of both man and animals through their attacks (7).

This is particularly true in the irrigated districts, where it is the common practice for out-door workers to protect themselves against attack by wearing veils, using repellents, etc. In such areas livestock often suffer much discomfort, with a consequent decrease in productive capacity.

However, it is not so well known that a definite health hazard also exists. This health hazard is mainly associated with encephalomyelitis (5, 6, 9, 13, 14), as *Aedes dorsalis*, *A. nigromaculis*, *A. vexans*, *Culex tarsalis*, and *Culiseta inornata* are carriers of the virus of this infection.

Recommendations

Irrigation developments in various parts of the United States have demonstrated that such developments are usually followed by an increase in the mosquito population unless consideration is given to ways and means of preventing mosquito-breeding areas from being established. It is recommended that in order to control the mosquito problem in the presently irrigated area and to prevent a similar problem from developing in the proposed irrigation areas serious consideration should be given to the following points:

1. *Reservoirs*. Should be planned, constructed and maintained so that:

(a) The banks are free from shrubs and aquatic vegetation where mosquito larvae and pupae could find food and shelter.

(b) All shallow flooded areas are diked off.

(c) Fluctuating water levels to coincide with recommended control methods are easily obtainable.

2. *Main Ditches and Laterals*. Construction and maintenance should strive to:

(a) Eliminate shallow and depressed areas of dead water.

(b) Prevent seepage.

(c) Eliminate flooding of surrounding lands.

(d) Keep ditches free from being clogged with vegetation.

3. *Spillways*. These should be designed to return the excess water to a natural water course.

4. *Drainage*. Adequate drainage should be supplied. If roadside ditches are used, they should be handled as spillways.

5. *Irrigation*. The duty of water has come in for considerable study and it has been demonstrated that it is most economical to utilize the water with a minimum of waste. An intensive educational program by competent irrigation engineers would not only increase the value of the used water but would also prevent excessive flooding and the establishing of mosquito-breeding areas. Consideration should also be given to the danger of raising the water table to a point where the land becomes water-logged.

6. *General*. A mosquito control program set up by a qualified entomologist should be an integral part of the administration of an irrigated district. Such a program would be established by means of lectures, etc., in schools and to farm groups. The value of this program would be shown not only in the reduction of the mosquito population, but also in the better use of land and water.

Conclusions

The mosquito situation in the present irrigated areas is bad, due mainly to a lack of any organized method for preventing the establishing of breeding grounds around reservoirs or for properly handling irrigation water so that excessive flooding will not take place. Unless such safeguards are established in relation to the extensive irrigation developments under way at present, the mosquito problem will become a serious agricultural and health hazard.

ACKNOWLEDGMENTS

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Poliomyelitis and Water Supply

G. M. LITTLE, M.D., D.P.H.
Medical Health Officer
Edmonton, Alberta

FROM time to time epidemiologists have suggested the transmission of poliomyelitis virus by water, but lack of evidence has created little enthusiasm for this possibility.

In 1943 Dr. Kenneth F. Maxcy of Baltimore stated:

"When poliomyelitis has invaded large urban communities whose population is served simultaneously by a common water supply, the cases have not been scattered in time, in place, and persons in the sudden random fashion which is expected. The disease has characteristically manifested a slow radial or progressive spread from an initial focus . . . Finally, and perhaps most important of all, there is on record at present not a single instance of an explosive outbreak of this disease which has been attributed to simultaneous exposure of a group of people to a common source of water." (1)

My own observation, as well as my study of the literature, entirely agrees with the above statement until our 1953 epidemic, when an exacerbation of what appeared to be a fairly usual curve of incidence in Edmonton flared up into a severe episode with the ear-marks of a water-borne transmission.

During the year 1952 our city had 95 reported cases of poliomyelitis with 7 deaths. This was the most severe epidemic experienced since 1927, and it was hoped that we might be attacked more lightly in 1953.

However, the year 1953 produced 322 reported cases, with 16 deaths. The census for that year gave Edmonton city a population of 183,411.

The curve of weekly incidence, shown in the accompanying graph, was less smooth than that of previous years. The two-weekly remissions were more obvious. Our peak week in previous years occurred invariably in late August or early September. What we assumed at the time to be our 1953 peak occurred in the week ending October 3rd—a month later than usual, with 20 cases reported for the week. By the end of October the weekly incidence of cases was reduced by half, and at that late period in the season we felt sure that the epidemic was subsiding.

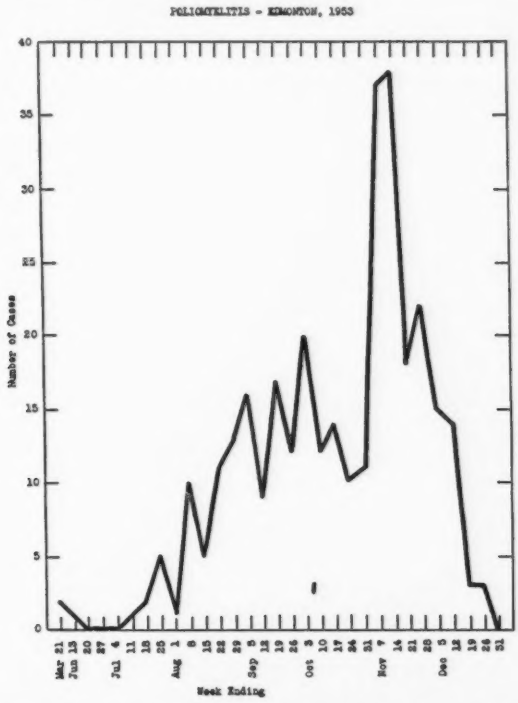
Then came the first week in November with 37 new cases. This explosive upsurge occurred at a period which, in previous years, gave only an occasional case to mark the lingering infection.

Furthermore, these new cases were distributed uniformly over the whole city, as were those occurring in the second week in November, which brought a further 38 new cases. This reminded one of the explosive water-borne epidemics of typhoid fever which fortunately have become rare in our country. The third week of November showed the epidemic subsiding again as depicted.

The sudden high incidence, 75 cases in a two-week period, so late in the season, and distributed so uniformly amongst our population, suggested some

new factor in the picture. The possibility of a common carrier fitted this picture so neatly as to demand consideration.

Pasteurized milk is supplied to our citizens by four dairy plants which are under constant supervision. The records show no failure of pasteurization during the weeks preceding the November flare-up. The virus of poliomyelitis is reported to be inactivated by pasteurizing temperatures (2). Further, there was no unusual preponderance of cases amongst the customers of any dairy. The milk seemed an unlikely vehicle of infection.



The only other common carrier apparent in this area is our water supply, which is obtained from the North Saskatchewan River. Twenty miles upriver from our water intake is the town of Devon, with a population of 1,600. Devon has sewerage, the sewage from which is treated by settling and chlorination of effluent before discharge into the river.

Some two years ago there occurred a number of cases of typhoid fever along the river above Edmonton and below Devon. The patients were drinking raw river water. A typhoid carrier was identified in Devon, where the chlorination of sewage effluent had failed temporarily.

Our water purification plant which settles, softens, filters and chlorinates the river water, was effective in preventing any case of typhoid at that time amongst those using our municipal water supply. However, it is doubtful if ordinary chlorination levels inactivate the virus of poliomyelitis (2).

At the time of the November 1953 exacerbation of the disease in Edmonton, it was found that chlorinating equipment at Devon was again giving trouble and chlorination of effluent was not consistent. Further, Dr. R. Cherry of Devon stated that 2 clinical and 10 suspect cases of poliomyelitis occurred in that town during September, and 3 clinical with 20 suspect cases in October.

Water temperatures in the river varied from 47°F. to 26°F. during October.

Chlorination of our water supply to near the threshold of taste and increased chlorination of effluent at Devon from November 14th was of doubtful value as the outbreak was at that time beginning to subside.

Summary

An explosive exacerbation of a poliomyelitis epidemic in Edmonton occurred at a time when the preceding epidemic curve and the lateness of the season gave reason to believe the epidemic was subsiding.

The cases of this late episode were distributed uniformly amongst the population. This distribution, in such a brief space of time, did not conform to our conception of the usual spread from contact infection.

A possible reservoir of infection was present in a town upstream from which inadequately treated sewage had access to our water supply. The virus of poliomyelitis has been demonstrated in sewage in the presence of this disease (3).

Ordinary chlorination of water is a doubtful protection against the virus.

Epidemiologically, this series of events suggests that Edmonton has suffered a water-borne outbreak of poliomyelitis. It provides, of course, only circumstantial evidence, but is recorded in the hope that cumulative evidence may help in time to complete and clarify the picture of this frustrating disease.

Our unsatisfactory control of poliomyelitis keeps the health officer hopefully anticipating the new venture in vaccination, and also looking forward to a more readily available means of identifying this virus.

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Canadian Field Trials on the Oral Use of Diphtheria Toxoid

L. GREENBERG, Ph.D.[1], F. R. CHOWN, M.D., D.P.H.[2], REBA E. WILLITS, M.D., D.P.H.[3], A. N. BEATTIE, M.D., D.P.H.[4], J. L. GAYTON, M. D., D.P.H.[5], AND G. C. KENNING, M.D., C.M.[6]

ATTEMPTS to immunize experimental animals against diphtheria by the oral administration of antitoxin date back to 1913 (1). In later studies, diphtheria toxin, antitoxin, and combined toxin-antitoxin mixtures have been used. All of these trials gave very poor or negative results.

The first success with the oral use of diphtheria toxoid was reported by Bousfield in 1945 (2). Hard pastilles containing 100 Lf of diphtheria toxoid were given to human volunteers over a period of seven days. The method appeared to be generally effective in subjects previously known to have been Schick-negative, or who, at time of immunization, had demonstrable diphtheria antitoxin in their sera, but did not appear capable of providing adequate stimulus for primary immunization. Petrini (3) and Masucci et al. (4) confirmed Bousfield's experiments. Both groups used tablets containing 100 Lf diphtheria toxoid. Excellent "booster" responses were obtained in adults and children, but attempts at "primary" immunization were unsuccessful.

The results of preliminary experiments on the oral immunization of guinea pigs and humans, carried out at the Laboratory of Hygiene, have been reported previously (5, 6). Following oral immunization, striking rises in diphtheria antitoxin were obtained in previously immunized guinea pigs. Moreover, attempts at primary immunization of normal guinea pigs yielded excellent results. The results with humans were not nearly so striking, but were sufficiently encouraging to show the need for further study.

The present studies were originally designed to determine the value of both diphtheria and tetanus toxoids, when given orally in a single preparation, as a booster dose. Upon assessing the results, it was found that the number in the study previously immunized against tetanus was too small to allow any conclusions to be drawn on the value of oral tetanus toxoid as a booster. The present report, therefore, relates solely to the results obtained with the diphtheria toxoid and deals with our attempts to determine (a) the pattern of antitoxin response following oral diphtheria toxoid and (b) the practical value of oral immunization against diphtheria. These studies are concerned

1. Chief, Biologics Control Laboratories, Laboratory of Hygiene, Department of National Health and Welfare, Ottawa, Canada.
2. Medical Director, St. Boniface Health Unit, St. Boniface, Manitoba. (Dr. Chown died on November 16, 1953).
3. Associate Director, School Health Services, Metropolitan Health Committee, Vancouver, B.C.
4. Saanich and South Vancouver Island Health Unit, Victoria, B.C.
5. Medical Health Officer, Victoria-Esquimalt Health Department, Victoria, B.C.
6. Oak Bay School Medical Officer, Oak Bay, B.C.

essentially with the "booster" effect, since previous studies, our own and others, have shown that oral immunization has little or no value in the primary immunization against diphtheria.

Procedure and Results

Two vehicles were used for the administration of the oral toxoid. The toxoid was incorporated in caramel candy for all but one of these studies. In the latter, chewing-gum toxoid was used. The toxoid caramels were prepared by the Lederle Laboratories, Pearl River, N.Y. A purified methanol-precipitated toxoid was used which, before incorporation in the caramel, was found by guinea pig assay to have approximately 70 per cent of the potency of the Laboratory of Hygiene's fluid diphtheria toxoid standard. Tests on the final product indicated that approximately 25 per cent of the toxoid was lost in the manufacturing process. Caramels labelled to have 1,000 Lf had, in fact, the activity of approximately 500 Lf, and caramels labelled 250 Lf had the activity of approximately 125 Lf. The more potent caramels are referred to in the text as having 500 Lf and the less potent ones as having 125 Lf. Similar reductions were noted for the tetanus toxoid fraction.

The toxoid chewing gum was prepared by Parke, Davis & Co., Detroit, Mich. A dried crude plain toxoid was used which by guinea pig assay, before mixing with the chewing gum, was found to be equal in potency to the Laboratory of Hygiene's fluid standard. Unfortunately, we were unsuccessful in our attempts to extract the toxoid from the chewing gum and were not able to assess the potency of the toxoid in the final preparation.

Pattern of Antitoxin Response Following Oral Immunization

For this phase of work, volunteers (all over 20 years of age) were obtained from the laboratory staffs of the Ottawa Civic Hospital, the Food and Drug Laboratories, Ottawa, and the Laboratory of Hygiene. These were organized into three groups. Blood samples were taken from each individual before immunization, 5 weeks and 3 months after immunization, and then at 3-month intervals until the study was completed. Group I were given toxoid caramels with 500 Lf diphtheria toxoid (see note above about potency of toxoid) at the rate of 3 a day for 6 days. Group II were given toxoid caramels with 125 Lf diphtheria toxoid 3 a day for 5 days. Both groups were asked to suck the caramels slowly, since it was suggested by Bousfield (2) that "the stimuli responsible for increases of titre take place only between the lips and, at the lowest, the lower end of the oesophagus". The members of Group III received toxoid chewing gum, containing 1000 Lf diphtheria toxoid and 500 Lf tetanus toxoid, at the rate of 3 sticks a day for 5 days. The latter group were asked to chew each stick for at least 30 minutes.

The results of this study are shown in Table I. A rise in average antitoxin titre was noted in each group. The immediate rise in antitoxin was rather modest compared with that ordinarily expected following parenteral booster doses. The maximum titre was reached between 5 weeks and 3 months. In all groups, the increased level was maintained for 15 months. On the 18th month, drops in the antitoxin levels were noted in Groups I and II; Group III was not followed for longer than 15 months.

TABLE I

THE PATTERN OF ANTITOXIN TITRES—FOLLOWING ORAL DIPHTHERIA TOXOID

Group* and Dose	No.	Antitoxin Titre—Units**							
		Before Immunization	5 Weeks	3 Months	6 Months	9 Months	12 Months	15 Months	18 Months
I Toxoid Caramels with 500 Lf diphtheria toxoid 3 a day for 6 days.	29	0.08	0.97	1.28	0.97	0.99	0.94	0.92	0.69
II Toxoid Caramels with 125 Lf diphtheria toxoid 3 a day for 5 days.	11	0.11	0.28	0.42	0.27	0.35	0.20	0.19	0.13
III Toxoid Chewing Gum with 1000 Lf diphtheria toxoid 3 a day for 5 days.	13	0.40	2.65	1.51	1.96	1.02	1.09	0.93	—

*See note in text regarding the potency of the oral preparations.
**The titre given is the arithmetic mean of the group concerned.

Field Trials with Oral Diphtheria Toxoid

To assess the practical value of oral immunization against diphtheria, a large field trial was carried out. Groups of human volunteers were obtained in Greater Victoria, Vancouver, and Winnipeg.

In the Victoria area, individuals of different ages from 9 years to over 20 years of age were obtained and included groups from public, elementary, junior high, high, and normal schools, and a group of nurses in training. Complete results were obtained on 271. The treatment for each group was the same. Each individual received 15 toxoid caramels containing 500 Lf diphtheria toxoid which were to be taken 3 a day for 5 successive days. Blood samples were taken immediately before toxoiding and, depending on circumstances, 8 to 14 months later. All sera were titrated for diphtheria antitoxin. The results of the titrations are shown in Table II.

TABLE II

RESULTS FOLLOWING ORAL DIPHTHERIA TOXOID—VICTORIA*

Group	Number Completing Study	Antitoxin Level at Completion of Study Number and Per Cent with			Group Averages—Antitoxin Titre—Units	
		Antitoxin Rise	Antitoxin Same	Antitoxin Drop	Before Immunization	After** Immunization
Elementary School	77	34 (40%)	33 (43%)	10 (13%)	0.67	0.70
Junior High School	64	34 (53%)	24 (38%)	6 (9%)	0.21	0.49
High School	36	16 (44%)	14 (39%)	6 (17%)	0.65	0.56
Normal School	46	27 (59%)	16 (35%)	3 (6%)	0.86	1.35
Student Nurses	48	25 (52%)	17 (35%)	6 (13%)	0.43	0.66

*Each subject received 3 toxoid caramels daily for 5 days.
**The normal-school group were titrated 6 months after immunization. The remainder, with the exception of a few student nurses at 8 months, were bled between 10 and 14 months.

In Vancouver, small representative groups were obtained from high schools and normal schools. About two-thirds of each group were given toxoid caramels (same strength as that noted above) at the rate of 3 caramels daily for 5 days. The remainder were used as parenteral controls and were given 0.25 cc. of a combined fluid diphtheria and tetanus toxoid subcutaneously. Blood samples were taken from all students immediately before toxoiding and 7 months later in the case of the normal-school students, and 12 months later in the case of the high-school students. Results were obtained from 134 and the titrations on these are shown in Table III.

TABLE III

RESULTS FOLLOWING ORAL AND PARENTERAL DIPHTHERIA TOXOID—VANCOUVER

Group		Immunization Route and Dosage	Number completing Study	Antitoxin Level at Completion of Study: Number and Per Cent with Antitoxin Rise	Antitoxin Same	Antitoxin Drop	Average Antitoxin Titre—Units: Before Immunization	After* Immunization
High School Students	A	Oral—3 toxoid caramels daily for 5 days.	69	39 (57%)	25 (36%)	5 (7%)	0.77	0.88
	B	Subcutaneous 0.25 cc. diphtheria toxoid (fluid)	30	26 (82%)	4 (18%)	0	0.72	3.04
Normal School Students	C	Oral—3 toxoid caramels daily for 5 days.	22	20 (91%)	2 (9%)	0	0.25	1.73
	D	Subcutaneous 0.25 cc. diphtheria toxoid (fluid).	13	13 (100%)	0	0	0.21	2.60

*12 months after for the high-school students, and 7 months for the normal-school group.

Our most ambitious program was undertaken in the Winnipeg area, where it was planned to immunize a group of approximately 900. Here, an attempt is being made to determine the optimal conditions (dosage, best method of administration, etc.) for this type of immunization. The greater part of the study has not yet been completed. The only results available at this time are from three small groups of normal-school students who were treated in the following manner. Group A received toxoid caramels (500 Lf diphtheria toxoid), 3 a day for 5 days. Group B received similar toxoid caramels but only one a day for 5 days; and Group C, the parenteral control group, were given 0.5 cc. of a combined alum precipitated diphtheria-tetanus toxoid (Lederle) subcutaneously. All groups were bled immediately before immunization and again 5 weeks and 7½ months later. The results of the antitoxin titrations are shown in Table IV.

From Tables II, III and IV, the following observations may be made. First, in the overall picture, only 50 to 60 per cent of those in the study derived measurable benefit from oral immunization. The elementary-school group in Victoria (Table II) derived least benefit, with only 40 per cent having increased antitoxin titres. The greatest benefit was noted in the normal-school students, Vancouver (Table III), where 91 per cent showed such increases. Second, there is a suggestion that the younger the age group the less the effectiveness of

TABLE IV

RESULTS FOLLOWING ORAL AND PARENTERAL DIPHTHERIA TOXOID—WINNIPEG NORMAL-SCHOOL STUDENTS

Immunization Route and Dosage	Number completing Study	Antitoxin Level at Completion of Study and Per Cent with			Average Antitoxin Titre—Units		
		Number Antitoxin Rise	Antitoxin Same	Antitoxin Drop	Before Immunization	After Immunization 5 weeks	7½ months
Oral—3 toxoid caramels daily for 5 days	66	44 (67%)	19 (29.5%)	3 (4.5%)	0.41	1.83	1.73
Oral—1 toxoid caramel daily for 5 days	57	36 (63%)	12 (21%)	9 (16%)	0.75	1.69	1.70
Subcutaneous 0.5 cc. alum precipitated diphtheria tetanus toxoid	59	53 (90%)	2 (3%)	4 (7%)	0.47	18.44	7.14

oral immunization. Finally, parenteral recall doses were significantly more effective than oral.

To study the two latter points, the results from each of the individual trials were pooled, special attention being paid to the age groups: 9 to 13, 14 to 18, 19 to 23, 24 and over. By correlating the results in this manner, a better overall view of results was made possible. It was felt that this step would be justifiable even though the experimental procedures and the preparations used were not identical in every instance. The pooled results of all the studies are presented in Table V. Here, the trend of the older age groups deriving greater benefit from oral recall doses may be more clearly noted. The group 9 to 13 years of age showed the least benefit, only 69 (47%) of 146 having increased diphtheria antitoxin titres. This percentage was increased with each rising age group, the greatest benefit being in those over 24 years of age, where 64 (75%) out of 85 had increased titres at the completion of the study. In the last column, the rate of increase (average of post-immunization titre divided by the average pre-immunization titre) is given. This column, too, emphasizes the trend of increasing benefit to the older age groups.

The pooled results with the parenteral control groups are also shown in Table V. The numbers in this part of the study were, unfortunately, small. There were only 6 in the group over 24 years of age, so that in this instance no

TABLE V

THE EFFECTIVENESS OF ORAL AND PARENTERAL BOOSTER DOSES OF DIPHTHERIA TOXOID IN DIFFERENT AGE GROUPS

Immunization Route	Age Group Years	Number completing Study	Antitoxin Level at Completion of Study and Per Cent with			Average Antitoxin Titre—Units		
			Number Antitoxin Rise	Antitoxin Same	Antitoxin Drop	Before Immunization	After Immunization	Rate of Increase Post Im'n. Titre / Pre Im'n. Titre
Oral	9 to 13	146	69 (47%)	60 (41%)	17 (12%)	0.46	0.59	1.3
	14 to 18	156	93 (60%)	46 (29%)	17 (11%)	0.73	1.40	1.92
	19 to 23	175	112 (64%)	51 (29%)	12 (7%)	0.53	1.14	2.2
	over 24	85	64 (75%)	16 (19%)	5 (6%)	0.37	0.99	2.7
Parenteral	14 to 18	51	46 (90%)	1 (2%)	4 (8%)	0.62	3.50	5.7
	19 to 23	32	29 (91%)	2 (6%)	1 (3%)	0.53	9.76	18.3
	over 24	6	4 (67%)	0	2 (33%)	0.06	3.59	59.8

conclusions can be drawn. It is apparent, however, that a far greater proportion benefited from the parenteral recall doses than from the oral, and furthermore, the average overall increase was also considerably greater. To determine whether the latter increase was due to the larger number in the parenteral group having increased resultant titres or to greater rises in the individuals concerned, the results of all our oral and parenteral studies were arranged so as to show both the titres before and after immunization for each individual on test. This is shown in Table VI. It will be noted that the final titres in both groups are more or less of the same order but there is a shift to the right (higher individual rises) for the parenteral group.

Discussion

The present report is primarily concerned with the use of oral diphtheria toxoid as a booster or recall dose for immunization against diphtheria.

It is known that parenteral booster doses in humans elicit a rapid response. A peak in antitoxin production is reached between 10 and 14 days following the booster, after which there is a gradual decrease in measurable antitoxin and a more or less constant level is reached in about 3 to 6 months. A different pattern results following oral recall doses (see Table I). The rapid response noted above is entirely absent. The increase in measurable diphtheria antitoxin is slow and, in some instances, increases may not be detectable for a month or more. The peak is reached between 5 weeks and 3 months and is followed by a gradual decrease. The increase in antitoxin titre (over the initial titre), when it occurs, is generally maintained for more than a year. These results are not in entire agreement with reports in the literature (2, 3, 4), where substantial increases in antitoxin titre were noted 14 days after oral immunization. It is possible that our dosage (considerably higher than that used by other investigators) or type of toxoid did not yield maximum results.

In our field trials comprising 651 persons, it was apparent that those on oral immunization did not benefit to the same degree as the parenteral controls. In the latter group, greater proportions showed benefit as judged by increased antitoxin titre and, furthermore, the individual increases were slightly higher. On the whole, the parenteral group benefited to a significantly greater degree than the oral.

In examining the results, a trend was indicated whereby it would appear that the older age groups derived greater benefit than the younger ones. This might have been expected. Practically all human immunization programs are directed towards immunization of infants and children. Because of this, the younger age group was undoubtedly more recently exposed to such immunization. In the circumstances, it would not be too unreasonable to expect that the children were either at or close to their maximum immunity, and that they would accordingly derive less benefit from a booster dose, either oral or parenteral, than older groups who are progressively further removed from immunization programs as they increase in age.

It would appear from these results that oral immunization against diphtheria is not a particularly practical procedure. In the present trials, 60 per cent of those receiving oral toxoid showed raised antitoxin levels 7 to 14 months

later, whereas 89 per cent of the parenteral control group showed benefit. The dosage schedule in most cases was heavy (1 to 3 caramels daily for 5 or 6 days), a procedure which is not always practical or even possible. Of the 562 receiving oral toxoid (Table VI), 66 (12%) had no measurable circulating diphtheria antitoxin before immunization. Of these, 30 (5%) derived no benefit and it is apparent that a more vigorous type of immunization is required for them.

Notwithstanding the above, oral immunization still may have a place in diphtheria immunization programs. While these figures are not impressive, we did not have normal control groups (i.e., groups that did not receive either oral or parenteral boosters) to serve as a basis for comparison. We, therefore, could not determine what the average fall in antitoxin levels might have been in the population at large. It is possible that those on oral immunization benefited to a greater degree than is apparent by the present results, even though they did not derive as much benefit as the parenterally immunized subjects. To date, we have given approximately 2,000 persons oral toxoid and no adverse reactions have been reported. This may be a matter of concern, particularly in adult immunization where reactions following parenteral toxoid can be quite severe. Oral immunization might well be considered in an area where a large proportion of adults (70% or more) have been previously toxoided, for even though the resulting demonstrable benefit in this series was not striking, repeat booster doses via the oral route for adults may be all that is necessary to elevate and maintain a high level of immunity in that segment of the population. The arguments against the adoption of this practice are (a) the large dosage and rather impractical administration procedure and (b) the results are uncertain and are considerably inferior to that obtained following parenteral immunization.

Summary

1. The present reported field trials comprising 651 persons have shown that oral diphtheria toxoid is not as effective as parenteral diphtheria toxoid as a secondary or booster dose in the immunization of humans against diphtheria. Approximately one year after immunization, only 60 per cent of 562 persons receiving oral toxoid had increased levels of circulating diphtheria antitoxin as compared with 89 per cent of 89 controls receiving parenteral toxoid.

2. Confirming results of previous studies, further evidence has been provided showing that oral diphtheria toxoid has little value for primary immunization against diphtheria.

3. Older age groups benefited from oral immunization to a significantly greater degree than younger age groups.

4. There were no reports of constitutional or intestinal disturbances in any of the subjects in the study who received oral immunization.

5. If the oral route is to have a place in immunization programs, it will most probably be for adult groups in which a high proportion have been previously immunized.

6. The use of the latter procedure would be more probable if the treatment could be reduced from the present 5-day schedule to one day, and the number of caramels significantly reduced.

TABLE VI

RISE IN SERUM ANTITOXIN IN PERSONS AFTER RECEIVING ORAL AND PARENTERAL DIPHTHERIA TOXOID

	No.	Original Titre	Final Diphtheria Antitoxin Titre—Units															
			0	.002	.004	.008	.016	.032	.064	.128	.256	.512	1.024	2.048	4.096	8.192	16.4	32.8
Oral	66	0	30	1	5	7	5	4	5	3	3	1		1	1			
	4	.002			2					1				1				
	25	.004	2		5	1	7	3	1	1		3	2					
	53	.008	3	1	3	3	6	7	10	5	7	3	4	1				
	38	.016					9	5	10	1	6	3	2	1	1			
	53	.032					1	16	6	7	6	6	4	4	2	1		
	56	.064						3	10	15	7	11	5	4	1			
	38	.128							1	9	8	12	4	1	3			
	59	.256								3	23	14	10	4	3	1		1
	52	.512								1	4	17	17	9	1	3		
	65	1.024										8	32	19	5	1		
	32	2.048										1	8	13	8	1	1	
	15	4.096									1		4	5	5			
	6	8.192												1	4			1
Parenteral	4	0	1		1	1	1											
	3	.004					1						2					
	10	.008							2	2		1	1	3	1			
	5	.016	2				1			1							1	
	14	.032	1				1			1		4	2	2	1		1	1
	11	.064									1	2	2	3	2	1		
	8	.128									1	2	1	1	2	1		
	13	.256										1	4	2	3	2	1	
	9	.512											3		3	1	1	1
	4	1.024												1	1	2		
	3	2.048													1		2	
	3	4.096													1		2	
	2	8.192															2	

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Measurement of Gingivitis among School-Age Children in Brantford, Sarnia, and Stratford, using the P-M-A Index

H. K. BROWN, D.D.S., D.D.P.H.,[1] F. A. KOHLI, D.D.S., D.D.P.H.,[2]
J. B. MACDONALD, D.D.S., M.S., Ph.D.,[3] AND
HUGH R. McLAREN, D.D.S., D.D.P.H.[1]

THE NEED for reliable epidemiological data on the prevalence of gingival disease has long been recognized. Before 1945, it was difficult to obtain data because of the lack of standardized methods of measurement in which the criteria were objective and quantitative. Consequently, reported observations on the prevalence of gingivitis and periodontal disease in large population groups were subjective and qualitative, and their statistical evaluation was rarely possible.

This study was undertaken primarily to determine the usefulness of the P–M–A index, proposed by Schour and Massler (1), in obtaining information on the nature and extent of gingivitis in large groups of Canadian school-age children. It was considered desirable to test the validity of this method, and also to evaluate the comparability of findings obtained by different examiners, using the P–M–A index, in measuring the prevalence of gingivitis in the same group. The latter phase of the study will be reported in a subsequent paper.

Definition of the P–M–A Index

In 1945 King (2) reported the first attempt to measure the prevalence of gingivitis in objective, quantitative terms. Following a study of gingivitis in various age groups in Italy in 1947, Schour and Massler (1) proposed a modification of King's method, which has been designated the P–M–A index.

In this method, the gingiva is divided into three distinct units: the papillary gingiva (P), the marginal gingiva (M), and the attached gingiva (A), according to Orban's description of gingival characteristics (3). (See Figure 1.) Use of the P–M–A index is based upon the observations of Schour, Massler and Chopra (4) that gingival inflammation almost invariably begins in the interdental papilla, spreading into the marginal and, ultimately, to the attached gingiva as the severity of inflammation increases. By observing and counting the numbers of affected papillary, marginal and attached gingival units, in that order, quantitative measurement of the extent of gingivitis is possible. In addition, this method of measurement should permit the evaluation of "mild", "moderate", and "severe" cases in more precise, objective terms.

Method

During this study, approximately 5,000 children between the ages of 6 and

[1]Dental Health Division, Department of National Health and Welfare, Ottawa.
[2]Dental Health Division, Department of Health of Ontario, Toronto.
[3]Division of Dental Research, Faculty of Dentistry, University of Toronto.

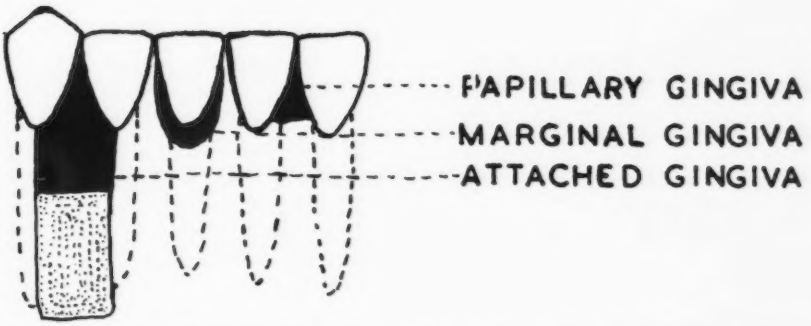

FIG. 1. Diagram illustrating differentiation of gingival units into parts (P–M–A), as proposed by Schour and Massler.
This illustration is reprinted with acknowledgments to Schour, Massler and Chopra (4).

14 years were examined. These children constituted the statistical sample-group of a dental-caries study in progress in Brantford, Sarnia, and Stratford (5). Age and sex distribution of the study-groups are shown in Table I.

Examinations were carried out by one examiner (F. A. K.), according to the procedure followed by Schour, Massler et al. in their study of gingivitis in suburban Chicago school-children (4). The examinations were made under a 100-watt examining light, with yellow bulb, kept at a constant distance from the subject's mouth. Tongue depressors were used in making the examinations.

Oral hygiene status was assessed by a second examiner (H. K. B.) as good, fair, or poor, according to the following criteria:

Good: teeth clean, lustrous; free from observable plaque, stains, materia alba or food debris; no calculus deposits, gingivae clean.

Fair: teeth not uniformly clean and lustrous; some observable traces of bacterial plaque; slight staining; no materia alba; occasional signs of recent food debris; slight calculus deposits; gingivae generally clean.

Poor: unmistakably unclean mouth; heavy, continuous bacterial plaque;

TABLE I

AGE AND SEX DISTRIBUTION OF CHILDREN EXAMINED IN THE BRANTFORD, SARNIA, AND STRATFORD GINGIVITIS (P–M–A) STUDY, 1951

Age	*Brantford*			*Sarnia*			*Stratford*		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
6	92	78	170	112	116	228	85	72	157
7	100	95	195	121	121	242	87	100	187
8	111	103	214	127	94	221	83	70	153
9	77	125	202	126	124	250	87	71	158
10	93	106	199	94	91	185	70	81	151
11	93	84	177	86	98	184	71	76	147
12	95	72	167	102	102	204	76	58	134
13	106	87	193	76	74	150	65	80	145
14	113	112	225	74	78	152	53	63	116
6–14	880	862	1,742	918	898	1,816	677	671	1,348

materia alba, staining and food debris in abundance; calculus deposits; gingivae unclean.

The gingiva adjacent to each tooth was examined, the interdental papilla mesial to each tooth being designated the papillary part (P) of the tooth's gingival unit (P–M–A). Findings were recorded in charts designed by Schour, Massler and Chopra (4) for use with the P–M–A. The presence of each inflamed papillary, marginal, and attached gingiva was recorded according to its geographical location; findings of the gingival unit (P–M–A) between the central incisors were recorded but once. Observations were made only on buccal and labial gingival tissues, not on the tissues lingual to the teeth.

Method of Processing Data

Frequency distribution of cases according to severity was made, using the class intervals selected by Schour, Massler et al. (4).

Degree	P–M–A Class-interval	
	P—M—A	
Gingivitis-free	0——0——0	
Mild gingivitis	1——0——0	to 2——1——0
Moderate gingivitis	3——2——0	to 5——2——0
Severe gingivitis	6——2——1	to 8——2——1
Very severe gingivitis	9——2——1	and above.

These class-intervals were selected by Schour and Massler in the following manner. The average P–M–A figure for the group examined by them (2–1–0) was selected arbitrarily to be the upper limit of the "mild" category; the assumption was that all cases having P–M–A counts below the group-average would fit into this category. Cases in which the extent (P–M–A) of gingivitis ranged from "average" to twice "average" counts were designated "moderate", while those in which the P–M–A count was greater than twice the group-average, but less than four times the group-average, were designated "severe". Cases with unusually high P–M–A counts were designated "very severe".

In processing the data obtained during the study of gingivitis in Brantford, Sarnia, and Stratford, it was found that while the average P–M–A counts were of the same order in both Brantford (2.0–1.0–0.3) and Sarnia (2.6–1.3–0.2) as in the Chicago study (4) reported by Schour, Massler et al., the average P–M–A count for the Stratford children was somewhat greater (4.7–2.7–0.6).

In constructing frequency-distribution tables of data obtained during the present study, it was found that a number of individual P–M–A counts did not fall into the class-intervals selected in the Chicago study (4). The degree of severity of each of these "misfit" cases was determined by considering both the total number of affected gingival units and the number of each type of gingival unit affected. Inflammation of a marginal gingiva is considered to be of greater severity than when the papilla only is involved; and an inflamed attached gingiva is considered to indicate greater severity than when inflammation is confined to the marginal gingiva.

Thus a case with a P–M–A count of 3—1—0 would be assigned to the "mild" category, since not only is the total number of affected gingival units less than that of the lower limit of the "moderate" category, but fewer marginal gingiva are affected. A case having a P–M–A count of 8—3—6 would be assigned to the "very severe" category; because although the "P" value is lower than the lower limit set for this category, the values of "M" and "A" are considerably greater than those set for the upper limit of the "severe" category, for these units.

Prevalence and Distribution of Gingivitis in Brantford, Sarnia and Stratford Children

The age distribution of gingivitis in children age 6–14 years, in Brantford, Sarnia, and Stratford is shown in Table II. The percentage of children affected (all ages 6–14 years) was 79.2% in Stratford, 63.1% in Sarnia, and 58.4% in Brantford. In the children of the three cities, the prevalence of gingivitis increases with age, from 6 years to 11–12 years. As may be seen in

TABLE II

PROPORTION OF CHILDREN AFFECTED BY GINGIVITIS AT VARIOUS AGES

	Age (Years)	No. Children	No. Affected	% Affected	Confidence Limits N. 250 Lower	Confidence Limits 95% Upper	X^2 Test $(O-E)^2/E$
I. Brantford	6	170	67	39.4	33	45	10.51
	7	195	102	52.3	46	58	1.24
	8	214	131	61.2	55	67	0.29
	9	202	127	62.9	57	69	0.69
	10	199	124	62.3	56	68	0.52
	11	177	114	64.4	58	70	1.09
	12	167	102	61.1	55	67	0.21
	13	193	105	54.4	48	60	0.53
	14	225	145	64.4	58	70	1.41
	T	1,742	1,017	58.4	52	64	16.49
			$X^2 = 16.49$, df = 8, $.02 < P < .05$				
II. Sarnia	6	228	91	39.9	34	46	19.45
	7	242	152	62.8	57	69	0.003
	8	221	139	62.9	57	69	0.002
	9	250	153	61.2	55	67	0.15
	10	185	129	69.7	64	76	1.30
	11	184	133	72.3	66	78	2.46
	12	204	143	70.1	64	76	1.59
	13	150	100	66.7	61	73	0.31
	14	152	105	69.1	63	75	0.86
	T	1,816	1,145	63.1	57	69	26.12
			$X^2 = 26.12$, df = 8, P = .001				
III. Stratford	6	157	90	57.3	51	63	9.46
	7	187	134	71.7	66	78	1.34
	8	153	124	81.0	76	86	0.06
	9	158	137	86.7	82	91	1.13
	10	151	126	83.4	78	88	0.34
	11	147	120	81.6	77	87	0.11
	12	134	109	81.3	76	86	0.08
	13	145	125	86.2	81	90	0.91
	14	116	103	88.8	84	93	1.34
	T	1,348	1,068	79.2	73	84	14.77
			$X^2 = 14.77$, df = 8, $.05 < P < .10$				

O — Observed number of children affected.
E — Expected number of children affected if no age relationship.

Table II, the prevalence of gingivitis at age 6 appears to be out of line with that of subsequent age-groups. Within the usual confidence limits for samples of the size examined in Brantford, Sarnia, and Stratford, as applied to these data, there is no significant relationship between the prevalence of gingivitis and age. (See Table III.)

Severity of Gingivitis Experience

The age-distribution of gingivitis by degree of severity is shown in Table III. Forty-one decimal six per cent of children in Brantford, 36.9% of the children in Sarnia, and only 20.8% of the children in Stratford were gingivitis-free. The distribution of cases, by age and degree of severity, was similar in both Brantford and Sarnia. Approximately one-third of the children examined in each of these cities were classified as "mild"cases. In Stratford, one-fourth of the children examined were "mild"cases. Distribution of "moderate", "severe", and "very severe"

TABLE III

PREVALENCE AND DISTRIBUTION OF GINGIVITIS BY PLACE AND AGE

	Age Years	Gingivitis Free			Mild			Moderate			Severe			Very Severe		
		% Obs.	C.L. L	C.L. U	% Obs.	C.L. L	C.L. U	% Obs.	C.L. L	C.L. U	% Obs.	C.L. L	C.L. U	% Obs.	C.L. L	C.L. U
Brantford	6	60.6	55	67	28.8	23	35	7.7	5	12	2.3	1	5	0.6	0	4
	7	47.7	42	54	35.9	30	42	12.3	8	17	2.6	1	6	1.5	1	5
	8	38.8	33	45	39.7	34	46	15.0	10	20	5.6	3	10	0.9	0	4
	9	37.1	31	43	35.1	29	41	20.3	15	26	3.5	2	7	4.0	2	7
	10	37.7	32	44	34.2	28	40	17.1	12	22	4.5	2	7	6.5	3	10
	11	35.6	30	42	33.3	27	39	17.5	13	23	7.9	5	12	5.7	3	10
	12	38.9	33	45	31.1	25	37	13.8	10	19	9.0	6	13	7.2	4	11
	13	45.6	40	52	28.0	22	34	13.5	10	19	6.7	4	11	6.2	3	10
	14	35.6	30	42	29.3	23	35	21.8	17	28	7.1	4	11	6.2	3	10
Sarnia	6	60.1	54	66	28.9	23	35	4.4	2	7	5.3	3	9	1.3	0	4
	7	37.2	31	43	42.6	37	49	12.8	9	18	4.5	2	7	2.9	1	6
	8	37.1	31	43	40.7	35	47	12.2	8	17	5.9	3	10	4.1	2	7
	9	38.8	33	45	35.2	29	41	13.2	9	18	6.4	3	10	6.4	3	10
	10	30.3	24	36	35.7	30	42	14.0	10	19	11.4	7	16	8.6	6	13
	11	27.7	22	34	35.3	29	41	18.0	13	23	8.7	6	13	10.3	7	14
	12	29.9	24	36	29.9	24	36	17.6	13	23	7.4	4	11	15.2	10	20
	13	33.3	27	39	24.7	20	31	17.3	12	22	16.7	12	22	8.0	5	12
	14	30.9	25	37	31.6	26	38	12.5	8	17	8.6	6	13	16.4	11	21
Stratford	6	42.7	37	49	29.3	23	35	12.1	8	17	10.8	7	16	5.1	3	9
	7	28.3	22	34	32.6	27	39	16.1	11	21	12.8	9	18	10.2	7	14
	8	19.0	14	24	30.7	25	37	16.3	11	21	13.7	10	19	20.3	15	26
	9	13.3	9	18	32.3	26	38	27.2	21	33	11.4	7	16	15.8	11	21
	10	16.6	12	22	21.8	17	28	21.2	16	27	15.2	10	20	25.2	20	31
	11	18.4	13	23	27.9	22	34	18.4	13	23	16.3	11	21	19.0	14	24
	12	18.7	14	24	22.4	17	28	9.7	7	14	17.9	13	23	31.3	25	37
	13	13.8	10	19	17.2	12	22	21.4	16	27	18.6	14	24	29.0	23	35
	14	11.2	7	16	21.6	17	28	21.6	17	28	19.8	15	26	25.8	20	32

Confidence Limits (C.L.): L — Lower, U — Upper; from Snedecor: Statistical Methods (4th ed.), Table 1.1.
95% Confidence Limits for Observed Percentages with Random Sample of Size N–250.

cases was on the same order in Brantford and Sarnia. A considerably higher percentage of children were classified as "severe" and "very severe" in Stratford than in Brantford or Sarnia

Average P–M–A counts for children examined in these three cities are shown in Fig. 2. The average P–M–A count tended to increase with age. Considering all ages, 6–14 years, the average P–M–A counts for Brantford children (2.0—1.0—0.3) and for Sarnia children (2.6—1.3—0.2) were found to be of the same order (2.0 – 1.0 – 0.3 and 2.6 – 1.3 – 0.2 respectively); those for the Stratford children were considerably higher (4.7 – 2.7 – 0.6). In both Brantford and Sarnia children, age-specific P–M–A counts appear to increase gradually from age 6 to 12 years. This pattern appears to differ somewhat in the case of the Stratford children, where peaks occurred at ages 7, 8, 10 and 12 years. The relationship between increasing severity of gingivitis (average P–M–A) and increasing age was not found to be significant in any of the three cities.

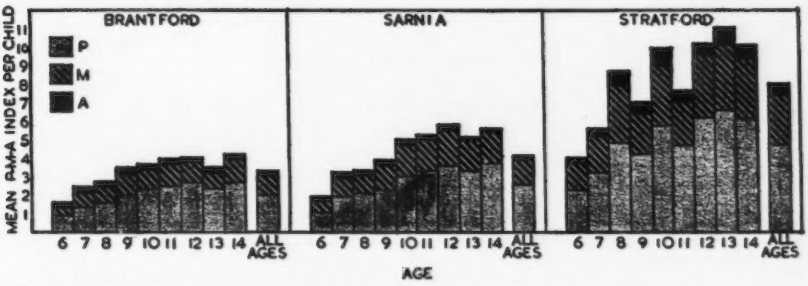

FIG. 2. Mean P–M–A counts for children in Brantford, Sarnia, and Stratford.

Gingivitis Experience and Sex Differences

In their study of gingivitis in Chicago school children, Schour, Massler et al. (4) reported statistically significant differences in gingivitis experience between boys and girls; girls aged 5–8 years and boys aged 9–14 years had the greater prevalence of gingivitis. Among children in Brantford, Sarnia, and Stratford, average P–M–A counts for boys and girls were of the same order (Table IV). Average P–M–A counts at individual age-levels differed between boys and girls in each city. Also, as observed by Schour, Massler et al. (4), girls aged 6 to 8 years tended to have more inflamed papillae than boys of similar ages, while in older age-groups the situation was reversed. In the present study, none of these observed differences was found to be statistically significant.

Gingivitis Experience and Oral Hygiene

Table V compares the gingivitis experience and oral-hygiene status of children in Brantford, Stratford, and Sarnia. There would appear to be an inverse relationship between gingivitis and oral-hygiene status. Brantford, which had the lowest prevalence of gingivitis (58.4%), had the highest percentage of children whose oral-hygiene status was classified as "good' (34.2%) and the lowest percentage of children with "poor" oral-hygiene status (33.0%). Stratford had the lowest percentage of children with "good" oral hygiene (10.0%), the highest percentage with "poor" oral hygiene (47.8%), and the greatest percentage of children affected by gingivitis (79.2%).

In order to determine whether this suggested relationship did exist between the presence of gingivitis and the status of oral hygiene, the children in each city were divided into groups according to oral-hygiene status, and each group was then counted according to gingivitis status. The chi square test shows the existence of a significant association between gingivitis and oral-hygiene status in all three cities.

Prevalence of Gingivitis as Determined by Examination of Anterior Segments of the Mouth only, in Comparison with Examination of the Whole Mouth

King (2) and Schour and Massler (4) have suggested that an accurate measurement of gingivitis experience in large population groups might be made by examining only the anterior

TABLE IV

COMPARISON OF GINGIVITIS EXPERIENCE OF BOYS AND GIRLS, AGED 6–14 YEARS, IN BRANTFORD, SARNIA, AND STRATFORD, 1951

Sex	Number Examined	Average P–M–A (whole mouth)	Affected with Gingivitis		Ging.-Free	Mild Ging.	Mod. Ging.	Severe Ging.	Very Severe Ging.
			No.	%					
I. BRANTFORD									
Boys	880	2.1–1.0–0.3	515	58.5%	41.5%	32.2%	16.8%	5.1%	4.4%
Girls	862	2.0–1.0–0.3	502	58.2%	41.8%	33.8%	14.5%	5.8%	4.1%
Total	1742	2.0–1.0–0.3	1017	58.4%	41.6%	32.9%	15.7%	5.5%	4.3%
II. SARNIA									
Boys	918	2.6–1.4–0.3	583	63.5%	36.5%	34.2%	14.4%	7.7%	7.2%
Girls	898	2.6–1.3–0.2	562	62.6%	37.4%	34.5%	12.2%	7.9%	8.0%
Total	1816	2.6–1.3–0.2	1145	63.1%	36.9%	34.4%	13.3%	7.8%	7.6%
III. STRATFORD									
Boys	677	4.7–2.7–0.7	538	79.5%	20.5%	27.3%	17.0%	16.9%	18.3%
Girls	671	4.8–2.6–0.6	530	79.0%	21.0%	25.9%	19.4%	13.0%	20.7%
Total	1348	4.7–2.7–0.6	1068	79.2%	20.8%	26.6%	18.2%	14.9%	19.5%

segments of the mouth. If this were so, the advantages, from the standpoint of time-saving and facility of examining large numbers of individuals, are obvious. Schour and Massler (4) have claimed statistical proof that examination of the anterior segments alone does provide a valid index of gingivitis experience of the entire mouth.

With a view to corroborating these findings, the data obtained in the present study were re-analyzed as if the anterior segments only had been examined. Results obtained were compared with the findings based on examinations of the whole mouth. Fig. 3 shows the comparison between findings based upon examination of anterior segments and those based upon examination of the whole mouth.

Had the prevalence of gingivitis been measured by examination of anterior segments alone, only 75.5% of cases found by the more complete method of examination would have been recorded in Brantford, 80.2% in Sarnia, and 90.4% in Stratford. Only one case in ten would have been missed in Stratford, while in Brantford between two and three of every ten cases would have been missed, as would two cases of every ten in Sarnia.

P–M–A Index Computed from Findings of Examination of Anterior Segments only, in Comparison with that Based upon Examination of Whole Mouth

Comparison of average P–M–A figures obtained by the two methods of examination indicates that, in each city, the P–M–A index would be about one-third lower when computed from data obtained by examining anterior segments only, than when data obtained by examining the whole mouth are employed (Fig. 3). When plotted against each other (Fig. 3), the average number of papillae and marginal gingivae affected derived from data obtained by both methods of examination, are found to be generally parallel in the three cities. Had the anterior segments only been examined, in Brantford only 62.5% of the total number of affected papillae and 61.3% of the total number of affected marginal gingivae would have been recorded; in Sarnia 60.0% of the total number of affected papillae and 60.3% of the affected marginal gingivae would have been recorded; and in Stratford, 64.5% of the total number of affected papillae and 71.6% of affected marginal gingivae would have been recorded. These figures are considerably lower

TABLE V

RELATIONSHIP OF GINGIVITIS TO ORAL-HYGIENE STATUS

I. Brantford — (Age 6–14 years inclusive)

	Oral Hygiene	Good		Fair		Poor		Total	
		No.	%	No.	%	No.	%	No.	%
Gingivitis	None	349	58.6	234	41.0	142	24.7	725	41.6
	Mild	184	30.9	202	35.4	188	32.7	574	32.9
	Moderate	48	8.0	99	17.3	126	21.9	273	15.7
	Severe	9	1.5	24	4.2	62	10.8	95	5.5
	Very Severe	6	1.0	12	2.1	57	9.9	75	4.3
	Total	596	100.0	571	100.0	575	100.0	1742	100.0

$X - 232.51$, df $- 8$, P 0.001

II. Sarnia — (Age 6–14 years inclusive)

	Oral Hygiene	Good		Fair		Poor		Total	
		No.	%	No.	%	No.	%	No.	%
Gingivitis	None	212	60.7	283	43.0	176	21.8	671	36.9
	Mild	107	30.7	244	37.0	273	33.8	624	34.4
	Moderate	17	4.9	72	10.9	152	18.8	241	13.3
	Severe	7	2.0	40	6.1	95	11.7	142	7.8
	Very Severe	6	1.7	20	3.0	112	13.9	138	7.6
	Total	349	100.0	659	100.0	808	100.0	1816	100.0

$X - 409.2$, df $- 8$, P 0.001

III. Stratford — (Age 6–14 years inclusive)

	Oral Hygiene	Good		Fair		Poor		Total	
		No.	%	No.	%	No.	%	No.	%
Gingivitis	None	51	37.5	144	25.3	85	13.2	280	20.8
	Mild	43	31.6	172	30.3	144	22.4	359	26.6
	Moderate	28	20.6	102	18.0	115	17.9	245	18.2
	Severe	9	6.6	81	14.3	111	17.2	201	14.9
	Very Severe	5	3.7	69	12.1	189	29.3	263	19.5
	Total	136	100.0	568	100.0	644	100.0	1348	100.0

$X - 211.7$, df $- 8$, P 0.001

Note: At all three centres, Brantford, Sarnia, and Stratford, there is a significant positive association between gingivitis and oral-hygiene status, e.g., among children having good oral hygiene there is a significantly higher proportion with mild gingivitis or none at all than among children having poor oral hygiene.

than those observed by Schour and Massler (4), who found that examination of the anterior segments only would reveal 80% of the papillae and 85% of marginal gingivae affected observed in whole mouth examinations.

Distribution of Gingivitis in the Anterior and Posterior Segments of the Mouth

Gingivitis was present in the anterior part of the mouth only in 20.6% of the Brantford children, 21.6% of the Sarnia children, and 25.2% of the Stratford children. Gingivitis in the

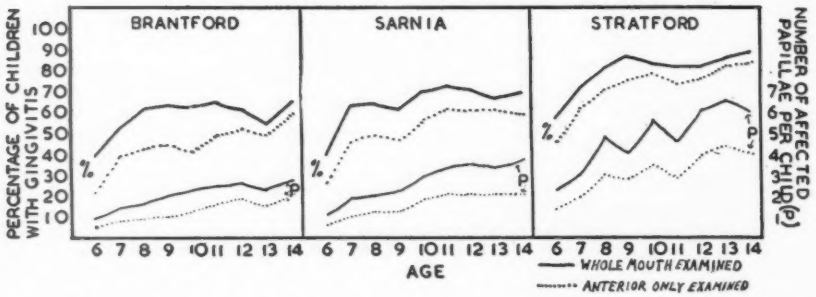

FIG. 3. Comparison of gingivitis experience in entire mouth and in anterior segments only, of children in Brantford, Sarnia and Stratford.

posterior part of the mouth only was found in 14.4% of the Brantford children, 12.5% of the Sarnia children, and 7.6% of the Stratford children. Gingivitis was present in both anterior and posterior segments of 23.4% of the children in Brantford, 29% of the children in Sarnia, and 46.4% of the children in Stratford.

Re-analysis of these data on the basis of affected children only, rather than in terms of the total number examined, shows (Figure 4) that in each of the three cities only about one-third

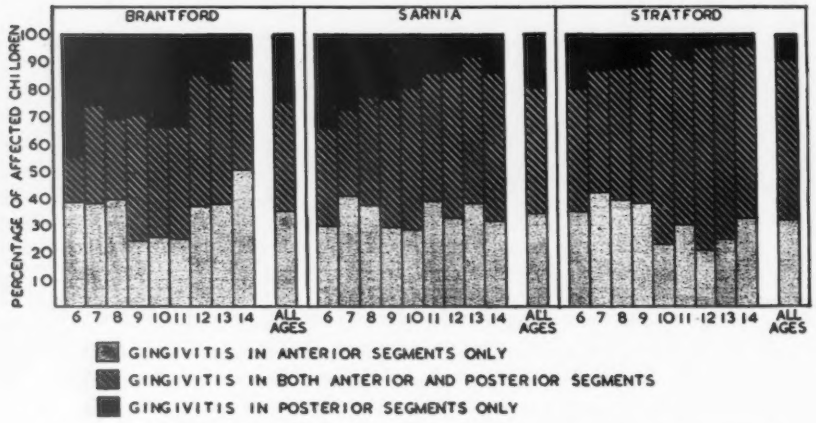

FIG. 4. Distribution of affected cases according to location of gingivitis in the mouth.

of the children affected with gingivitis had all gingival inflammation confined to the anterior part of the mouth (Brantford 35.2%, Sarnia 34.3%, Stratford 31.8%). In Stratford, 9.7% of affected children had gingivitis only in the anterior part of the mouth, while 19.7% of affected children in Sarnia and 24.7% of affected children in Brantford were found to have posterior gingivitis only. Gingivitis in both anterior and posterior segments of the mouth was observed in 40.1% of the affected Brantford children, 45.9% of the affected Sarnia children, and 58.5% of the affected group in Stratford.

DISCUSSION

The prevalence of gingivitis in the children examined in Brantford, Sarnia, and Stratford appears to be on the order of that reported in studies of children

of similar age in various parts of the world. In the Brantford and Sarnia groups the distribution of affected cases, by degree of severity, when made according to the procedure suggested by Schour, Massler, et al. (4), follows the pattern reported by these authors. In the Stratford children, it does not.

In their report of a study of gingivitis in suburban Chicago children, Schour, Massler and Chopra (4) stated that the percentage of children affected with gingivitis increased significantly with increasing age, and that the same relationship existed between increasing severity of gingivitis. Examination of the data obtained during the present study reveals that, within the usual confidence limits, no significant relationship exists between gingivitis and age in the case of children examined in Brantford, Sarnia, and Stratford. Nor is there demonstrated any significant difference between gingivitis experience of boys and girls at any age beween 6 and 14 years.

It has been reported (4) that a reliable index of the prevalence of gingivitis would be obtained if only the anterior gingival segments of the mouth were examined. The findings of our study do not confirm this. In the three groups of children the cases missed would have ranged from 10% to 25% had observations been made on the anterior segments only.

In general, the P–M–A index for each group would have been about one-third less than actually was observed, had it been computed on the basis of examining the anterior gingival segments alone. In all three groups of children included in the present study, the differences are considerably greater than those observed by Schour, Massler et al., who reported that 82–85% of affected papillary and marginal gingival units would be detected in an examination of only anterior gingivae.

The findings of this study reveal the existence of an inverse correlation between the prevalence of gingivitis and oral-hygiene status. The results of the chi square test show this relationship to be significant in all three population groups under study. The variation in the proportions of children affected in Brantford, Sarnia, and Stratford is a reflection of oral-hygiene status in the three cities.

It is worth noting that these three cities furnish the study samples in a study of water fluoridation (5). Stratford water contains fluorides naturally at a level of 1.3 parts per million. Fluoride has been added to the Brantford water for a period of approximately eight years to obtain a concentration of between 1.0 and 1.2 parts per million. Sarnia's water supply is fluoride-free. There appears not to be a significant relationship between the presence of fluoride in the water supply and the occurrence of gingivitis. Gingivitis prevalence and severity were found to be equivalent in Brantford, where the water is fluoridated, and in Sarnia, where the water is fluoride-free. One might speculate that the high incidence of gingivitis in Stratford children reflects a public carelessness in respect to oral hygiene, attributable to low caries rates of long standing.

While it appears that the proposed P–M–A Index has certain usefulness in the evaluation of the prevalence of gingivitis, its use in attempting to estimate quantitatively the proportions of persons affected by gingivitis, in varying degrees of severity, is open to question. The average P–M–A Index is said to

be determined by totalling affected gingival units. In actual practice, it is the affected parts (P, M, A) of the gingival units which are totalled; and these affected parts are not necessarily components of the same gingival units. This means that a localized gingivitis may receive the same emphasis as widespread gingivitis.

It would seem most reasonable to use the gingival unit as the basis for measurements of gingivitis-prevalence. An estimate of severity could be made by applying to the affected gingival unit a severity-rating scale, which could be based upon the extension of inflammation from P to M to A. A combination of the count of affected gingival units and such a severity-rating factor would permit the presentation of data in more simple and consistent form than is possible with the P–M–A Index. It is desirable, both statistically and logically, that this be done.

The method of basing the limits of the various categories of severity of gingivitis upon the group-average P–M–A count does not appear to be adequate. Not all the possible or even probable index values are provided for in the ranges specified for the five degrees of severity used in the P–M–A Index method. Some scheme must be devised for allocating "misfit" cases to another category of severity. The inherent difficulty of quantitatively assessing a factor that is qualitative in nature, such as the degree of severity, thus becomes compounded by the addition of what must be, despite the most strictly adhered to criteria, a highly subjective factor. A distribution of affected cases according to observed P–M–A counts would be more informative.

Summary

A study of gingivitis among three groups of Canadian children, of school-age, was undertaken to test the usefulness and validity of the P–M–A Index method in the quantitative evaluation of gingivitis.

The percentage of children affected by gingivitis increased with age in all three groups of children studied. There was no significant relationship between age and the prevalence of gingivitis in any of the three groups of children.

As determined by the P–M–A Index, the severity of gingivitis appeared to increase as age increased. This was found to be not statistically significant.

No significant differences, in either the numbers affected or in the proportions of various categories of severity of gingivitis, were found to exist between boys and girls in any of the three groups studied.

Gingivitis experience was found to be similar, both in prevalence and in severity, among children examined in Brantford and in Sarnia. Among Stratford children, the percentage of children affected, and the severity of gingivitis as determined by the average P–M–A count, were greater than among children in Brantford and in Sarnia.

An inverse correlation, which is statistically significant, was demonstrated between gingivitis and oral hygiene status among children examined in each of the three cities studied.

The findings of this study do not support, statistically, the validity of examining only the anterior gingival segments of the mouth in order to assess entire gingivitis experience.

The value of the P–M–A Index in the quantitative measurement of gingivitis prevalence according to the degree of severity of inflammation is questionable. It would appear, also, that the gingival unit, rather than its parts (P, M, A), would be the more satisfactory basis for measurement of the prevalence of gingivitis.

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FEDERAL GRANTS FOR HEALTH SERVICES

IN 1935 the Social Security Act was passed by the United States Congress. It provided not only for measures relating to social security but also grants-in-aids to State authorities to assist in public health programs. The first provision of grants for health work was made under the Sheppard-Towner Act of 1921, which empowered the Children's Bureau to give financial assistance in the development of child and maternal health programs at the State level. These grants were discontinued in 1929 but were renewed with the passage of the Social Security Act. Grants for public health have been made in increasing amounts since 1935. Fears were expressed that the giving of grants to State authorities, and indirectly to local authorities, might result in reduced appropriations on the part of the recipients. In a recent address, Dr. Martha M. Eliot, chief of the Children's Bureau in the U.S. Department of Health, Education and Welfare, presented the facts, reviewing the period 1940 to 1954. In 1940, the State and local maternal and child health programs were financed by a budget of about 11.5 million dollars. Of this amount, 6 millions were from State and local funds and 5.5 millions from Federal funds. This year the total amount budgetted for maternal and child health programs is 40.5 millions, nearly four times as much as in 1940. Of this the States are providing 30 millions and the Federal Government 10.5 millions. The States have increased their appropriations nearly three times, while the Federal Government has doubled its contribution. Thus the stimulus of the Federal grants has resulted in greatly increased appropriations from State and local funds. The experience in regard to the grants provided by the other divisions of the Department of Health, Education and Welfare parallels that of the Children's Bureau in augmenting State and local support.

In his "State of the Union" message, presented to Congress last January, President Eisenhower made reference to the continuation of present Federal programs and indicated that a new approach to the objectives of grants-in-aid was desirable. He pointed out that in each of the grants-in-aid programs, including those dealing with health, child welfare, and rehabilitation of the disabled, a wide variety of matching formulae have been used. Funds have been restricted to specified purposes, with the result that too much money has

been available for some programs and not enough for others. A new concept of Federal participation in State programs was outlined by the President. Recently Mrs. Oveta Culp Hobby, Secretary of the Department, presented to Congress some changes of a fundamental nature in keeping with the President's forecast. It is purposed to permit the States to use greater initiative and to take more responsibility. Federal support will be based on three general criteria. (1) The States are to be aided in inverse proportion to their financial capacity; thus States that have the greatest need will receive the largest support. (2) The States will be helped in proportion to their population to extend and improve the welfare services. (3) A portion of the Federal assistance will be set aside for the support of unique projects of regional or national significance which give promise of providing better ways of serving the needs of the citizens. These include rehabilitation of the disabled and the construction of medical-care facilities, including hospitals, nursing and convalescent homes, and diagnostic or treatment centres for ambulatory patients.

This new approach reflects the experience in Great Britain, where "block" grants were introduced more than twenty years ago. It was recognized that assistance should be given on the basis of need rather than population. Block grants have been heartily endorsed by local authorities, and the experience has demonstrated the wisdom of this policy.

The provision of health grants in Canada in 1948 marked a new era in public health history in this country. The first five years of the National Health Program have been completed, and the value of the grants in advancing public health, including the provision of hospital facilities, is recognized by all health authorities. Through the combined efforts of local, provincial and Federal authorities and of the public, more than 46,000 additional hospital beds have been made available. Through the Professional Training Grant, bursaries have been given to nearly 5,000 health workers, including a large number of nurses. A remarkable increase in medical research has followed the provision of the Public Health Research Grant. This year the applications for support under this grant have greatly exceeded the funds available, in contrast with 1948, when only a small part of the grant was requested. Equally striking evidence of their value can be presented for the remaining eight grants of the National Health Program.

The principle which has guided the making of grants in Great Britain, the United States, and Canada has been the providing of assistance to permit of new services or the extension of existing services. A matching formula has been employed in Canada in the Venereal Disease Control Grant and the Cancer Control Grant; and a share has been assumed in the construction of new hospital facilities. A transfer of funds from the two matching grants has been permitted for such purposes as bursaries for professional training and for capital expenditures which in both instances relate to the immediate year and are non-continuing expenditures. The grants are designated for specified purposes and, with the above exceptions, the transfer of funds is not provided for. The experience of the five years has indicated that the same problems which have arisen in the United States are evident in the administration of the grants-in-aid program in Canada—problems which are inherent in the limita-

tions attached to the grants. The proposals now before the Congress of the United States might well be the subject of study in Canada in order to make the grants even more effective.

THE MILTON J. ROSENAU MEMORIAL FUND

IN 1909 Dr. Milton J. Rosenau established in Harvard University the first department of preventive medicine in a civilian medical school in the United States. In 1913, with Sedgwick and Whipple, he founded the first post-graduate school of public health on this continent. In that year also he published "Preventive Medicine and Hygiene", which through the years has been the accepted textbook for students not only on this continent but also in many other countries. Dr. Rosenau was a great teacher and many thousands of students were inspired by him to give their best in the service of preventive medicine. Permeating his teaching was his conviction that the welfare of every citizen should be our greatest concern.

Announcement has been made of the establishment of the Milton J. Rosenau Memorial Fund at the Harvard School of Public Health. It will be used to advance public health teaching, research, and service. The sponsors of the Fund include the surviving past-presidents of the American Public Health Association, of which Dr. Rosenau was president-elect at the time of his death in 1946.

Public health authorities in Canada will welcome the establishing of this memorial to Dr. Rosenau. Contributions may be sent to the Secretary, Harvard School of Public Health, 55 Shattuck Street, Boston 35, Massachusetts.

First Canadian Medical Care Conference

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Canadian Public Health Association

(see inside back cover)

Forty-Second Annual Meeting
Canadian Public Health Association
Quebec, May 31 - June 2, 1954

Bienvenue à Québec en Mai!

THE world-wide reputation of Quebec, which will be host to the members of the Canadian Public Health Association and its provincial branch, la Société d'Hygiène et de Médecine Préventive de la Province de Québec, next May, is not merely confined to the Old City, but is shared by its beautiful and historic environs. Few cities in the world have as many natural objects of attraction in this respect. It is a difficult matter to sketch the history of Quebec. It also is difficult to describe the sites of the greatest historical interest, because so much history is confined in so small a space that the importance attached to one place is apt to overshadow that of another.

Since the year 1867, the date of Confederation, Quebec has been the seat of government of the Province of Quebec. The residence of the Lieutenant-Governor, Bois de Coulonge, is well worth a visit from the stranger.

Quebec is unique throughout the whole of Canada as being the place where many notable events were first recorded. Hebert became the first of the "habitants" in 1617; Giffard the first of the "seigneurs" in 1634. The first play ever performed was Corneille's *Le Cid*, in 1646. The first licensed tavern was established here in 1648. The Quebec Gazette, ancestor of the present senior Canadian newspaper, The Quebec Chronicle-Telegraph, began bilingual publication in 1764. The first of all the French-Canadian papers, Le Canadien, was founded here in 1806. The first Royal review in Canada was held here in honour of the future King William IV in 1787. The first tender for any steam transport in Canada, and one of the very first in the whole world, was submitted here, on behalf of the *Swiftsure*, in 1812. The first French-Canadian university, Laval, was founded here, by Royal Charter, in 1852. Archbishop Taschereau became the first Canadian Cardinal in 1886. Confederation was agreed upon at Quebec in 1864 and proclaimed here in 1867. The national anthem, O Canada, was first sung at Quebec in 1880. And the first reigning Sovereign to set foot upon Canadian soil, King George VI, made his first landing here, with Queen Elizabeth, in 1939.

The business of getting about Quebec is easy, and many means are at the disposal of visitors. If you are motoring, you can hire a guide who will explain all about the various places of interest—and there are many. Who has not heard of the calèche, a two-wheel carriage, or the old-fashioned buggies. They are a unique feature of Quebec City and may be hired.

Among the outstanding points of interest in old Quebec, the following are particularly worthy of mention. The old church of Notre Dame des

Victoires is architecturally rather insignificant, but it is nevertheless one of the most interesting historical edifices in Quebec. It was erected in 1688 and contains countless old relics and fine paintings by old masters. The BASILICA dates back to 1647. It was damaged and partially destroyed by fire on two occasions, but rebuilt with the same walls. In addition to rich treasures, it contains several paintings of great beauty.

The ANGLICAN CATHEDRAL, dedicated in 1804, is the first Church of England cathedral ever built outside the British Isles. The interior is worthy of inspection. When one enters, time goes back almost two centuries. Its vaults contain records of the births, marriages and deaths in the Parish since 1768. The mural tablets are over 100 years old, and the stained windows are works of art. The SEMINARY was founded in 1633 by Monseigneur de Laval, first bishop of Quebec. LAVAL University, an outgrowth of the Seminary, ranks amongst the leading universities of this continent. The URSULINES' CONVENT, founded in 1639, is the most ancient in Canada. Its educational system is justly renowned all over America. The HOTEL DIEU HOSPITAL, founded in 1639, is one of the oldest hospital institutions on the continent. The nuns have many great paintings by old masters and fine old furniture and silver dating to the 17th century. The interior of the PARLIAMENT BUILDINGS is well worth inspection, especially the handsomely tiled main corridors and the richly furnished chambers of the Legislative Assembly and the Legislative Council, the only provincial Legislative Council in Canada. The Provincial Museum, situated on the Plains of Abraham, contains many things of interest to the visitor. In addition, Quebec has countless monuments, old buildings, old narrow streets, terraces, etc.

The Château Frontenac, headquarters for the Association's meeting, opened its doors more than sixty years ago. The first of the eastern hotels in the Canadian Pacific's nation-wide chain, it was built in 1893 high on the cliff that towers over the Lower Town and the St. Lawrence River. The site was well chosen. Here once stood the Château St. Louis, official residence of the early governors of New France. A short distance to the west is the Citadel, for many years the key to half a continent. New wings were added to the hotel in 1899, 1909 and 1922; the central tower was opened in 1924; and further major improvements were made in 1926. Great names of Canadian history have been given to the larger public rooms: Jacques Cartier, Champlain, and Frontenac. Few hotels anywhere have had their royal suites occupied as often as the Château Frontenac. It has housed King George V; Their Majesties King George VI and Queen Elizabeth, during the Royal visit in 1939; the Duke of Windsor, when he was Prince of Wales; Prince Henry, Duke of Gloucester; the King and Queen of Siam; Princess Juliana of The Netherlands; and the Governors-General of Canada, from the Earl of Aberdeen to Field-Marshal Viscount Alexander. The name of Sir Wilfrid Laurier, the great French-Canadian statesman, was first inscribed on the register of January 3, 1894, when he and his wife were listed as M. and Mme. Laurier from Arthabaska, his constituency.

Dufferin Terrace, favourite spot for the evening "promenade" of the residents of the City, is directly in front of the Château. In the courtyard a plaque records that the hostelry was the headquarters of the staffs of the armed forces present at the 1943 and 1944 Roosevelt-Churchill meetings as guests of Canada.

It can be said that the environs of Quebec City are not surpassed, or even excelled, in romantic and picturesque beauty. From almost any vantage point, the visitor will see before him a glorious panorama.

NEWS

Alberta

THE LARGEST EPIDEMIC of poliomyelitis in Alberta's history is just subsiding. There has been an unusually high incidence of the bulbar type and a large number of patients are in respirators. The Province provides a very complete service for the treatment and after-care of poliomyelitis patients, as well as a rehabilitation program. In addition, ten thousand dollars was given this year to the College of Physicians and Surgeons for the purpose of investigating the care of poliomyelitis cases, especially those in respirators. The College also plans to make recommendations regarding the organization of poliomyelitis treatment in case of future epidemics. It is expected that a report will be ready in May. A number of unusual features were noted in this year's epidemic, and a special team was established to study the epidemiology of the disease. The team is headed by Dr. E. S. Orford Smith, assisted by Miss Beatrice Cole.

THE INCREASING GROWTH of population in Alberta and the development of a number of industries in the Edmonton area, has increased the problems in relation to the pollution of the North Saskatchewan River. At the present time, Alberta's stream-pollution team assisted by industrial hygiene workers from Ottawa and with the co-operation of various industries and the Alberta and National Research Councils, is working on this problem. The immediate question relates to disagreeable odours and tastes in the water, complaints having arisen from as far away as Prince Albert, Saskatchewan, and The Pas, Manitoba. A number of hopeful leads have been followed, but in spite of months of work, no definite answer is yet available.

Saskatchewan

TO AFFORD the public an opportunity to hear an authoritative discussion on poliomyelitis and to ask questions, polio panels are being conducted in a number of centres in the Regina Rural Health Region. The discussants are Dr. Irial Gogan, regional medical health officer, Dr. Stanley Best, director of child health for the Department of Public Health, and a local physician. These meetings are being sponsored by local organizations such as Boards of Trade, Home and School Associations, and lodges. They are intended to present facts concerning poliomyelitis to alleviate some of the public concern associated with this disease. Sessions have been well attended so far and excellent co-operation has been given the health region staff by the communities involved.

FOR THE PAST THREE YEARS, live drama has supplemented other media and techniques employed by the Health Education Division in its mental health education program. One-act stage plays, which present familiar family situations and problems and involve the audience in group discussion, are being used extensively by community organizations throughout the province. Production kits, prepared by the Division, and scripts are supplied free of charge to interested groups. This help is supplemented, when possible, by the personal assistance of Miss Rowena Hawkings, M.A., health educator on the Division's headquarters staff, who is in charge of the mental health play projects. The sketch being used currently is AND YOU NEVER KNOW, written by Nora Sterling, author of the Temperate Zone Series of plays. By spring, a voluntary Regina cast will have served about 15 organizations in and around Regina. As an experiment, this project was presented at The Saskatchewan Hospital, Weyburn, to a professional audience of some 250 psychiatrists, psychologists, doctors, nurses, teachers, and clergy, and the consensus was that the theatre technique is more effective than the other media in dealing with family problems because the "liveliness of the acted-out situation involves people more quickly."

"BLACK LIGHT" DEMONSTRATIONS are being being used by medical health officers in Saskatchewan health regions as a quick and effective means of showing restaurant operators and employees how food, table utensils, and kitchenware may be soiled and contaminated by careless handling. Food handlers attending institutes in Saskatoon and Indian Head were given literature which had been treated with a fluorescent paste not visible in ordinary light. After an interval, a quartz

lamp was used to show what had happened. Red smears were observed not only on dishes and kitchen equipment but on the faces, hair, mouth, and noses of the astonished "guinea pigs." Such demonstrations will become a feature of institutes for food handlers in Saskatchewan. The Division of Health Education assists the regional medical health officers in organizing and conducting these institutes.

DR. HERMAN O. DILLENBERG, a native of Leipzig, Germany, was appointed recently medical bacteriologist for the Saskatchewan Government's Provincial Laboratories. He graduated in medicine from the University of Berlin in 1938 and then interned for a year in a hospital in Cologne. Afterwards, Dr. Dillenberg spent two and one-half years in post-graduate work in bacteriology and virology at the German Institute for Virus and Typhus Research in Krakow, Poland. In 1942 he received his doctorate degree after presenting a dissertation on the serology of typhus. He gained experience in field hygiene in Russia and in parasitology in North Italy and, after the war, acted as assistant hygienist in the American Prisoner-of-War Camp at Ghedi, North Italy. From 1947–51, Dr. Dillenberg practised medicine in Berlin, then worked as a hygienist in Switzerland, Italy, and Sweden. On coming to Canada in May, 1952, he acted for five months as assistant bacteriologist at the Regina General Hospital before taking a year's internship at the same hospital.

Manitoba

THE FOURTH ANNUAL INSTITUTE for Sanitary Inspectors was held on the University of Manitoba campus, March 2 to 5. The Institute, attended by approximately fifty inspectors from Winnipeg and rural areas, was arranged in co-operation with the University by the Department of Health and Public Welfare and financed by a Federal Grant.

THE RURAL MUNICIPALITIES of Hamiota and Blanchard, as well as the village of Hamiota, joined the Virden laboratory and x-ray unit in January. A dearth of public health nurses prevents their receiving full-time Health Unit services.

DR. J. N. SCATLIFF, who has headed the Red River Health Unit since 1951, has been appointed Medical Director for the St. Boniface Health Unit. Dr. Scatliff succeeds the late Dr. F. R. Chown.

NURSING CARE OF THE POLIO patient was subject of a five-day course conducted in Winnipeg March 8 to 12 by Miss Barbara Williams of New York. The course, sponsored by the Manitoba Association of Registered Nurses, the University School of Nursing Education and the Department of Health and Public Welfare, was attended by a selected group of nursing instructors from hospitals and health agencies in the province. Miss Williams is nursing consultant from the Nursing Advisory Services for Orthopedics and Poliomyeltis of the National League for Nursing in New York.

HOSPITAL MATRONS throughout Manitoba will meet March 22 to 26, to attend lectures on aspects of hospital administration. Among the subjects discussed will be the selection, orientation of personnel, legal responsibility in hospital care, nursing ethics, hospital emergency services, and the administration of drugs in hospitals. The course has been arranged by the University School of Nursing and the Department of Adult Education, the Manitoba Association of Registered Nurses, the Associated Hospitals of Manitoba and the Department of Health and Public Welfare.

THE APPOINTMENT has been announced of Dr. J. J. Prag as Director of the Provincial Bacteriological Laboratory. A native of Johannesburg, Dr. Prag received his degree as bachelor of medicine, bachelor of surgery and master of science at the University there. After serving with the South African Medical Corps in South Africa and the Middle East, Dr. Prag was appointed assistant government pathologist in Pretoria, S.A. His next appointment as senior government assistant at Capetown terminated when he left on a travelling fellowship to do post-graduate work at Glasgow University. There, Dr. Prag obtained his M.D. and D.P.H. and was awarded the McKinley prize for Public Health. His last appointment was to the East London provincial government in South Africa as senior pathologist. Dr. Prag is succeeding Dr. G. B. Leyton at the provincial laboratory.

Ontario

THE HOSPITAL ADMISSION x-ray program being conducted in 160 hospitals in Ontario has shown marked headway in the last few

months, in the detection both of unsuspected tuberculosis and other chest diseases among patients. A recent survey by provincial health authorities shows that in 1953 approximately 325,000 patients were x-rayed on admission to hospital. For the three-month period ending December 31, 1953, 79 per cent of all hospitals reported a coverage of more than 70 per cent of patients x-rayed. For the quarter ending June 30, 1953, 76 per cent reported the same coverage.

A NUMBER of recommendations were made by the Select Legislative Committee on The Cemeteries Act and Related Matters in their report tabled at a recent session of the Ontario Legislature. Several are of particular interest to health authorities. The report calls for overall supervision of cemeteries by the Ontario Department of Health, with the appointment of a three-man advisory board and field men charged with seeing that regulations are carried out. At present control is divided between the department and local boards of health.

DR. GEORGE W. MILLER, epidemiologist with the Ontario Department of Health's Division of Venereal Disease Control for two years, has been appointed national director of the Blood Transfusion Service, the Canadian Red Cross Society. He was formerly with the World Health Organization in Geneva, Switzerland, and had extensive public health service in India. In 1945, Dr. Miller was assistant medical officer of health of the Northumberland-Durham Health Unit.

MR. JACK MCDOUGALL, C.S.I.(C.), has joined the staff of the Ontario Department of Health's Division of Industrial Hygiene as bedding and fumigation inspector. Mr. McDougall was formerly a sanitary inspector with the Etobicoke Health Department.

New Brunswick

THE HONOURABLE J. F. MCINERNEY, M.D., C.M., Minister of Health and Social Services, attended a meeting of the Ministers of Health of the Maritime Provinces and Newfoundland with the Inter-Provincial Committee at Halifax, Nova Scotia, on January 20, 21 and 22. He was accompanied by Dr. J. A. Melanson, D.P.H., Chief Medical Officer, and Dr. A. M. Clarke, D.P.H., Director of Health Planning Services. This was the first meeting of all the Ministers of Health of the Atlantic Provinces.

DR. D. F. V. BRUNSDON, formerly of Surrey, England, has reported to the Department of Health and Social Services and assumed duties as pathologist with the Provincial Bureau of Laboratories, at Saint John.

WORK ON THE PROVINCE'S new Polio Clinic and Health Centre at Fredericton is going ahead rapidly. The structure, which adjoins the Victoria Public Hospital, will care for poliomyelitis patients and crippled children and will provide quarters for a Regional Zone Laboratory. It is expected that the building will be completed early next fall.

WORK ON THE NEW Provincial Hospital at Campbellton is nearing completion. It is expected that the institution will be ready to accept mental patients in May of this year. In its initial phase, the portion of the Hospital now completed will accommodate 225 patients.

MR. G. WILFRED CRAMDLEMERE assumed his duties as Rehabilitation Officer for the Department on March 1. He will direct and co-ordinate a province-wide program of rehabilitation of disabled persons.

DR. J. R. MAYERS, D.P.H., Director of Maternal and Child Health, has reported that the infant mortality rate in the Province stands at 43 infant deaths per 1,000 live births. This is the first time that the rate has dropped below 50.

THE PROVINCIAL SCHOOL LUNCH PROGRAM continues to be an effective medium both for the promotion of health education and also for improvment of school children's nutrition by supplementary meals. It takes two years to carry out the work in each county, involving the full-time attention of one nutritionist. To date, eleven counties have been organized and follow-ups carried out in eight of them. It is worthy of note that in the county follow-up it has been found that 85% of the rural schools are operating a school-lunch program.

EMPLOYMENT SERVICE

Medical Officer of Health required by the Corporation of the City of Ottawa. Applications are to be made, stating qualifications and experience in detail, to the Secretary, Board of Control, Corporation of the City of Ottawa, 48 Rideau Street, Ottawa, Ontario. 2–4

The Stony Plain–Lac Ste. Anne Health Unit No. 17, near Edmonton, Alberta, requires a Registered Nurse with public health qualifications to start immediately. Minimum salary $2,640. per annum and increments of $140 × 3 and $260 × 1. Starting salary by arrangement. Applications stating qualifications should be addressed to the Director of the Health Unit, Stony Plain, Alberta. 2–4

Medical Director required for Kenora–Keewatin–Dryden Area Health Unit. Duties will commence immediately. Population of Unit area 22,700. Liberal automobile allowance. Pleasant working conditions. Please address application to Box 174, Kenora, Ontario, stating qualifications, experience and salary expected. 2–4

Medical Officer of Health wanted by York County Health Unit as assistant to Director and M.O.H. Excellent opportunity for association in the development of an expanding program in a young urban-rural health unit adjacent to Metropolitan Toronto. Write to Dr. R. M. King, Director, or to W. B. Epworth, Secretary, York County Health Unit, Newmarket, Ontario. 2–4

Director of Dental Services wanted. Salary range $6,500–$7,500. Qualifications: Diploma in Dental Public Health. Apply—Local Board of Health, Civic Block, Edmonton, Alberta. 3

Public Health Nurses required for generalised program in a rural-suburban health unit near Toronto. Excellent salaries. Pension plan. For full details, write Supervisor, Peel County Health Unit, Court House, Brampton, Ontario. 3–4

Assistant Medical Officer of Health: Applications are invited for the appointment of Assistant Medical Officer of Health in the City of Peterborough, duties to commence July 1, 1954, or as convenient. Starting salary $6,000 per annum, subject to adjustments according to experience. Submit application or request for information to Dr. J. P. Wells, Medical Officer of Health, City Hall, Peterborough, Ontario. 3–5